THE HEATING AND VENTILATING MAGAZINE

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SOME NOVEL HOT WATER HEATING SYSTEMS

BY DR. ALFRED GRADENWITZ

Many endeavors have been made to augment the speed of circulation in hot water heating systems, the action of which is generally based merely on the difference in temperature between the hot water rising from the boiler to the radiators and the colder water returning from the radiators to the boiler. Steam injectors, pumps, vacuum spaces and other means have been used in this connection, but the most successful solutions of the problem are doubtless due to two Danish firms, namely, the Reck Heating Co., of Hellerup, Denmark, and Messrs. Bruun & Söerensen, of Copenhagen.

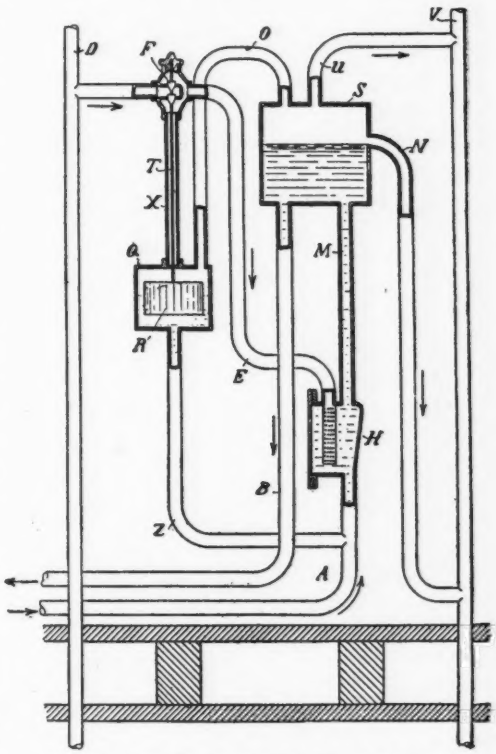
I.—CIRCULATION SYSTEM

In the circulator system, designed by the Reck firm, the desired result is obtained by injecting steam at a fairly small distance below a separator at the end of the rising tube or else by generating steam, so as to have a mixture of steam and water in the uppermost part of the rising pipe.

In Fig. 1 is represented a sectional view of this system. From the main supply pipe, *V*, the hot water flows through branch pipes to the various radiators, giving off part of its heat there and returning through the main return pipe, *A*, to the heating vessel, *H*. The end of the steam pipe, *E*, terminating in the heating vessel and conveying the steam from the main steam pipe through the double valve, *F*, is perforated so as to admit the steam noiselessly.

The reservoir, *S*, intended for separating the steam from the water is connected with the heating vessel by the pipe , *M*, it is fitted with an overflow pipe, *N*, discharging the water generated by condensation of the steam into a vertical pipe.

Through the pipe *U* some air and steam may escape from the reservoir, *S*, into the pipe, *V*, while the pipe, *O*, connects the reservoir, *S*, to the compartment, *Q*, which in turn is connected with the return pipe, *A*, by the pipe, *Z*, immediately below the



SOME NOVEL HOT WATER HEATING SYSTEMS. FIG. 1

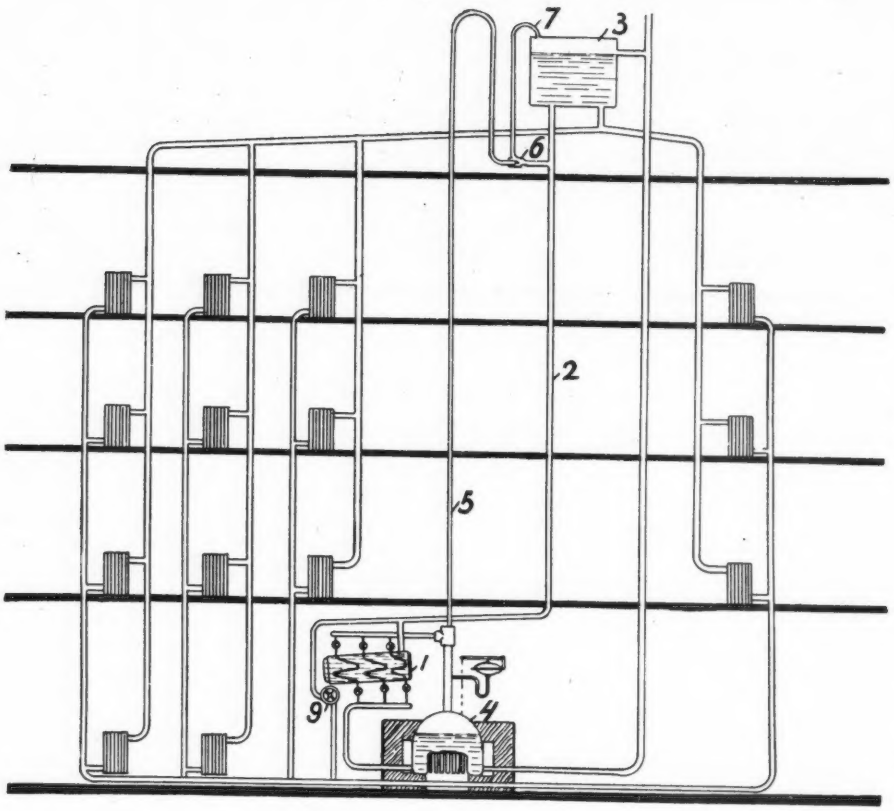


FIG. 2

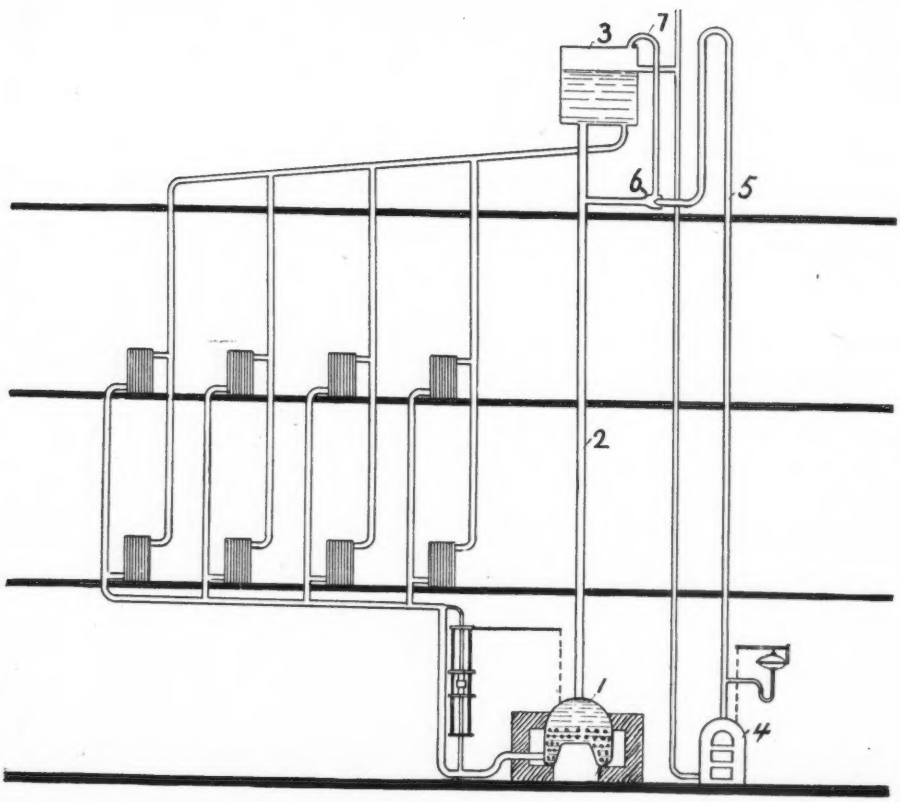


FIG. 3

SOME NOVEL HOT WATER HEATING SYSTEMS

vessel, *H*. In the compartment *Q*, there is a float, *R*, attached to the rod, *T*, of the valve, *F*. The valve casing is connected with the outside of the compartment, *Q*, by a pipe, *X*. In the casing of the compartment, *Q*, there is an aperture of exactly the same diameter as the rod, *T*, so that the latter is allowed to move freely up and down, while steam is prevented from escaping from *X* to *Q*.

This device will work as follows: With the pipe, *V*, open and with atmospheric pressure in the steam pipe, *D*, the water will fill the compartment, *Q*, and the pipe, *O*, up to the level of the water in the reservoir, *S*, so that the float, *R*, keeps the valve, *F*, open. As soon as the steam pressure in the pipe, *D*, increases sufficiently steam will pass through the valve, *F*, and the pipe, *E*, to the heating vessel, *H*, there heating the water until a mixture of steam and water rises in the pipe, *M*, resulting in the water being sucked from the pipe *A*. At the same time some water will be drawn down the pipe *Z*, so that the water in the pipe, *O*, and the compartment, *Q*, dropping the float, *R*, will fall down and close the valve, *F*, just enough to allow an amount of steam to pass through the pipe, *E*, sufficient to maintain an aspiration on the water in the pipe, *A*, so that the water level in the pipe, *O*, and in the compartment, *Q*, is maintained at about a medium height between compartment *Q* and the pipe *E*.

The effect of the compartment *Q*, the float *R*, the valve *F*, and their connections thus consists in maintaining the velocity at which the water traverses the radiators with a minimum consumption of steam, the valve being closed and opened by the float *R*, according as the suction effect in the tube *A* exceeds or falls short of the pressure desired. By connecting the pipe *V* to the suction pipe of a pump, the temperature at which the water boils in the reservoir, *S*, may be reduced more or less below 100° C.

II.—"AERO-CIRCUIT" SYSTEM

In the Aero-Circuit system, patented by Bruun & Söerensen, the air as implied by its name is utilized for increasing the circulation. This process presents the advantage that a general regulation of the heat is possible, as the tubular pump will act whether the water be cold or hot. The velocity of the water in the pipes will be constant with any consumption of heat, and if the temperature of the water be reduced the heating power of all the radiators will be reduced accordingly.

In Fig. 2 the system is shown with a steam boiler and a steam heater, while Figs. 3 and 4 show a hot water boiler and a steam boiler, which in Fig. 3 have each its fireplace and in Fig. 4 a fireplace in common.

The steam is conveyed from the steam boiler 4 to the injector 6, which blows air into the rising pipe 2. The air ascends with the water into the expansion tank, 3, and passes through the pipe 7 back to the injector to be blown again, thus circulating in a continuous flow. The hot water system operates in the ordinary way, and may be single or double pipe. Should circumstances require it, the radiators may be placed lower than the hot water boiler.

Tests have shown the pressure of circulation to be about 40 per cent. of the height of the rising pipe from the injector to its entrance into the expansion tank. The steam serving to blow in the air must have a pressure of about twice the whole column of water above the injector.

A pressure of 0.35 to 0.37 atmospheres will as a rule be sufficient, giving a pressure of circulation of about 500 millemeters of water column. The consumption of steam in the injector will be 15 to 25 per cent. of the aggregate heat of the system; the maximum temperature of the flowing water may at will vary from 95 to 35° C., without altering the ratio between the calorific power of the different radiators, equal quantities of water being conveyed

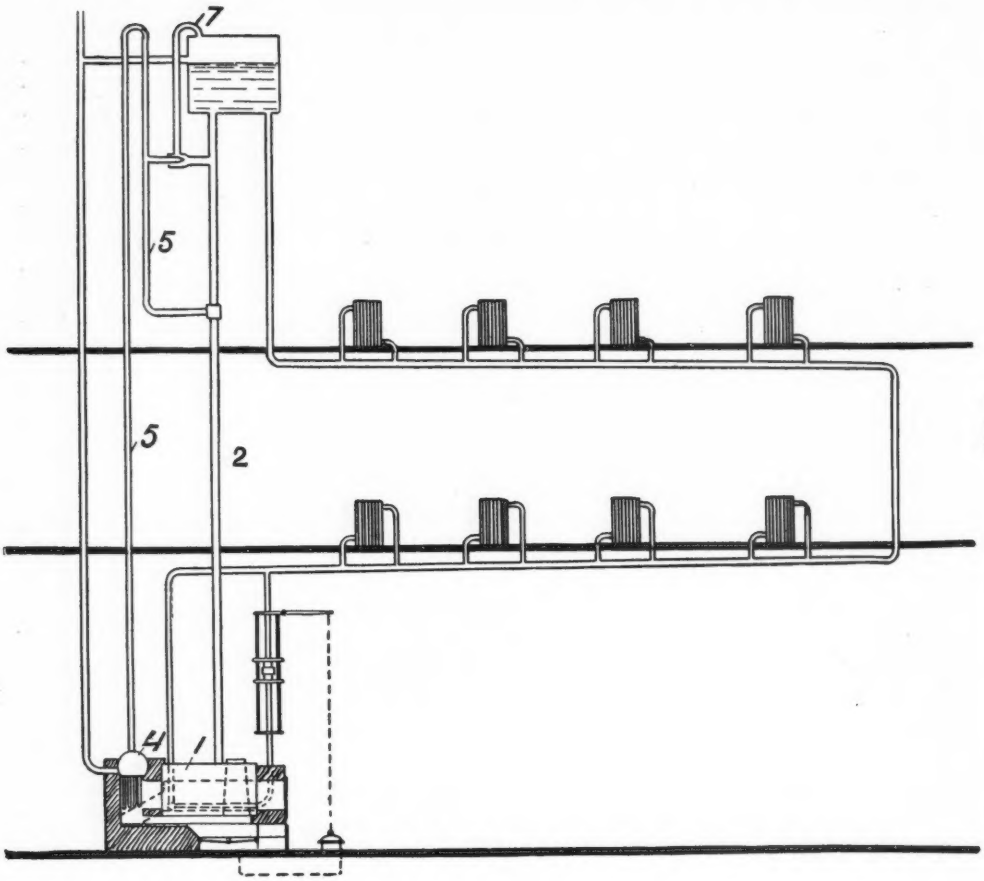


FIG. 5

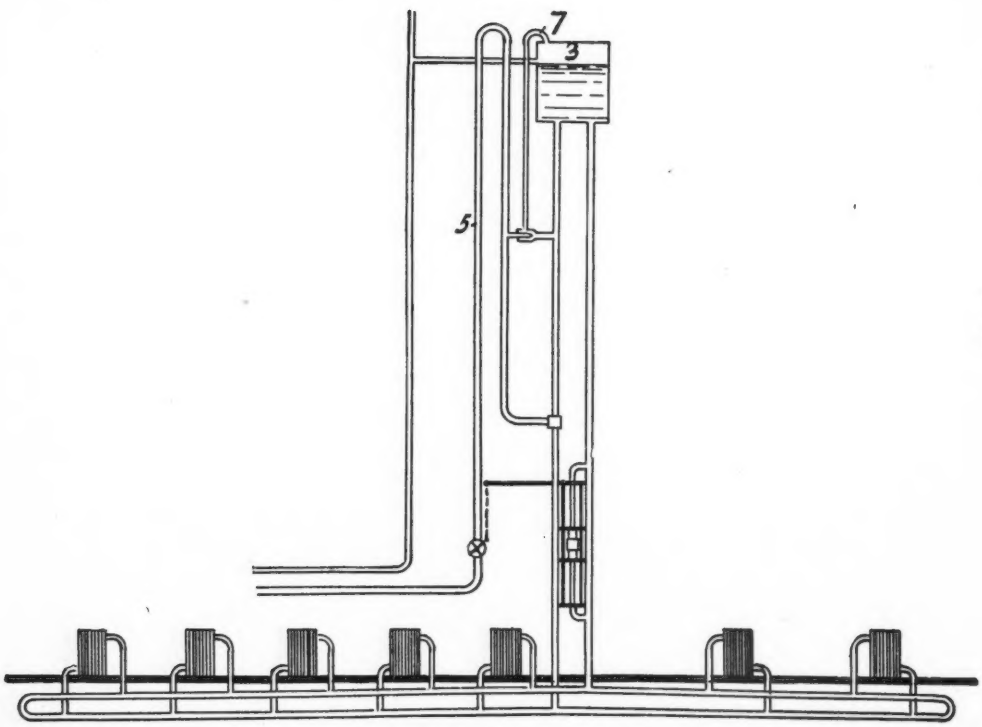


FIG. 6

SOME NOVEL HOT WATER HEATING SYSTEMS

to them. The general regulation is more perfect than in the ordinary system. The Brunn & Sörensen system will therefore be especially adapted for use in schools and hospitals, where a temperature as constant and as easily adjustable as possible is required.

From Fig. 2 it will be seen that the temperature of the water is controlled by regulating the admission of steam into the steam heater. A more exact regulation is furthermore attainable by adjusting the three way cock 9 on the return pipe of the water system so that more or less return water is diverted from the steam heater and mixed with the hot water of the rising pipe. By connecting the three-way cock 9 with a thermo-regulator, the temperature of the water may be kept constant.

As seen by Fig. 3, the water boiler may be fitted also with an automatic thermo-regulator, keeping the temperature of the water constant, while the regulator of the steam boiler, 4, maintains a constant steam pressure which is governed by the height of the water level above the injector.

In Fig. 4 the water and the steam boilers have a fireplace in common and combustion is regulated by an automatic regulator operated by the water in the system. If the consumption of heat be great, the boiler will produce more steam than necessary. The steam pipe, 5, is therefore led downward from the ejector and enters into the rising pipe of the water system, so far below the surface of the water in the expansion tank that the steam pressure is always sufficient to blow in air. If the steam production be greater than required, the surplus steam will pass into the rising pipe and contribute to the heating of the system. The boiler must be so large that even with the slightest amount of firing it will yield a sufficient quantity of steam.

This system is especially fitted for use in works where steam is already available, when, no steam boiler being required, a material saving may be effected. This type of the system is illustrated in Fig. 5, where the heating is entirely operated by the direct introduction of steam into the rising pipe, 5, so that even the steam heater may be dispensed with. In this shape the system seems to be particularly adapted for the heating of blocks of buildings and factories, where steam is available at a pressure of about 0.35 atmospheres.

COMPUTATION OF RADIATING SURFACE

By J. Byers Holbrook, M.E.

The maintainance of a unform temperature being a prime object of any heating system, its requirements are such as to demand no little consideration and study. These requirements may be summarized briefly as follows:

(*a*) Replacing the heat lost by convection and radiation from walls, windows and exposed surfaces.

(*b*) Heating to a desired temperature the air supplied for ventilation.

(*c*) Heating a certain amount of air admitted by cracks, window sashes, etc.

The second requirement (*b*) is extremely flexible and difficult to determine in all heating work, save in fan systems or those including mechanical ventilation.

The third requirement (*c*) is likewise an unkonwn quantity, and its amount hardly determinable.

These two quantities of air are combined and considered as one term in the radiation formula.

Much study has been devoted to this branch of engineering, and numerous calculations by different authorities, from Péclet down, have appeared in numerous text books, etc. These vary to such an extent that the writer believes that an inspection of these various formulas will be of some interest.

Before contrasting these formulas

it will be well to consider the heat losses through walls and glass surfaces.

The amount of heat in British thermal units transmitted per hour per square foot of surface (brick wall) per degree difference of temperature ranges all the way (for four-inch to eighteen-inch walls) from .24 to .68. The average twelve-inch brick wall would show approximately .34 of a unit transmitted per square foot. The writer in his practice uses a value of .25 for the average typical city building wall.

The amount of heat in B. T. U.'s transmitted per hour per square foot of glass (average single window) per degree difference of temperature ranges between .91 and 1.08. Some authorities have given even higher values than the latter. For practical purposes we may consider this amount of heat lost as one unit.

The amount of heat required for ventilation is found as follows: A cubic foot of air at 60 or 70 degrees F. weighs approximately 0.0745 pound; in other words, there are 13.4 cubic feet to the pound. The specific heat of this air at constant pressure is 0.2375, and accordingly one B. T. U. will heat 55.8 cubic feet of air 1 degree F. This is usually taken as 55.

Now, by dividing by 55 the product of the amount of air in cubic feet required for a certain room per hour, and the difference of temperature between the required room temperature and the temperature of the outside air, we know at once how many B. T. U.'s are required for warming the air for ventilation.

This amount of air for ventilation, or the hourly air change as already referred to, is extremely flexible and is the only really variable quantity in the radiation formula.

It is figured at various values by different authorities. Carpenter figures between one and a half to two hourly air changes (for office buildings), while other authorities allow all the way from less than one hour air change to two and three changes of air per hour. The writer in his practice figures on one change of air per hour for the average type of city building, increasing this somewhat for rooms on the first floor, and also for the halls and corridors generally throughout the building.

The amount of heat given off by direct radiating surfaces has been pretty accurately determined from various radiator tests performed during the past few years.

As a result of these tests and investigations it has been found that the amount of heat radiated by direct surfaces per degree difference of temperature between the temperature of steam and the temperature of the surrounding air per square foot per hour is approximately between 1.6 to 1.8 B. T. U.

Accordingly, assuming a temperature of 212 degrees for steam at atmospheric pressure and a temperature of 70 degrees for the room, the difference would be $212 - 70 = 142$ degrees. And therefore the total heat radiated per square foot of surface per hour would be 1.8 B. T. U. $\times$ 142° = 255 B. T. U.

The average radiation gives off approximately 250 B. T. U. per square foot per hour. Less radiant heat is given off, and accordingly the radiator's efficiency is decreased, as the number of rows in a radiator is increased. It is a matter of fact that wall coils, on account of the freer circulation of air offered, are approximately between 30 and 40 per cent. more efficient than the ordinary two-column cast iron radiator.

It has now been shown how much heat is required to compensate for that lost through walls and windows and the amount also required for ventilation. The sum of these various heat units multiplied by the desired temperature of the room, and this product divided by 250 (B. T. U.'s radiated per square foot per hour), will give the amount of direct radiation in square feet required for warming to the desired temperature.

In the following formulas as given by various authorities we will designate the terms as follows:

R = number of square feet of radiating surface required; G = the square feet of glass surface; W = the square feet of exposed wall surface, and V = the volume or cubical contents of room to be heated. (Heating from zero to 70 degrees.)

Mills' Rule:

$R = 0.50\ G + 0.05\ W + 0.005\ V$ (A)

Willett's Rule:

$R = 0.48\ G + 0.08\ W + 0.002\ V$ (B)

Monroe's Rule:

$R = 0.42\ G + 0.08\ W + 0.0026\ V$ (C)

Carpenter's Rule:

$$R = \frac{1}{4}\left(G + \frac{W}{4} + \frac{N \times V}{55}\right) \qquad (D)$$

Where N = number of air changes per hour; with N = 1 then the above becomes:

$R = 0.324\ G + 0.08\ W + 0.006\ V$ (E)

Lawler's Rule:

$R = 0.332\ G + 0.0332\ W + 0.01\ V$ (F)

The Babcock & Wilcox Company, in their publication, *Steam*, give the following rule:

$$R = \frac{\left(G + \text{cu. ft air per min.} + \frac{W}{20}\right)}{212^\circ - 70^\circ} \times (70^\circ - 0^\circ) \quad (G)$$

Deducing and eliminating the temperature figures we have:

$R = 0.49\ G + 0.0245\ W + 0.49 \times$ cu. ft. air per min. from which, and figuring one air change per hour, we have:

$R = 0.49\ G + 0.0245\ W + 0.0081\ V$

The writer in his practice uses the following:

$R = 0.28\ G + 0.07\ W + 0.0051\ V$ (H)

This formula is derived as follows and from the following assumptions:

1 B. T. U. transmitted per sq. ft. of glass surface per hour.

¼ B. T. U. transmitted per sq. ft. of average masonry wall per hour.

Hence the average heat loss for each degree difference of temperature is that which is transmitted through the glass surface in square feet and one-quarter of the wall surface in square feet, or

Average heat loss for 1° difference of temperature = square feet glass + ¼ square feet wall.

For usual temperature (60 to 70 degrees) of rooms one B. T. U. will warm 55 cubic feet of air one degree F., as has been previously explained.

From the above we then have the total heat to supply per degree difference of temperature is:

$$\text{Sq. ft. glass} + \tfrac{1}{4}\text{ sq. ft. wall} + \frac{\text{air change per hr.} \times \text{Vol.}}{55}$$

$$\text{or } G + \tfrac{1}{4}W + \frac{N \times V}{55} \qquad (1)$$

The average direct radiator will give off approximately 250 H. U. per square foot per hour when using steam from atmosphere up to say three pounds' pressure.

Temperature of Steam.. = 212°
Temperature of Air..... = 70°

Difference..... = 142°

The number of B. T. U.'s radiated per degree difference of temperature per square foot per hour at these above pressures is 1.8.

Hence total heat units =

$$1.8 \times 142^\circ = 255 \qquad (2)$$

This we will take at 250 to be on the safe side.

From this equation (1) becomes:

$$\text{Total heat to supply} = 70\left(G + \tfrac{1}{4}W + \frac{n \times V}{55}\right) \quad (3)$$

And as each square foot of radiating surface gives off 250 H. U. per hour, then the required amount of radiation in square feet (R) is as follows:

$$R = \frac{70}{250}\left(G + \tfrac{1}{4}W + \frac{n \times V}{55}\right) \qquad (4)$$

Figuring the air change as once per hour, we have, neglecting the volume,

$$\frac{n}{55} = \frac{1}{55} = 0.0182$$

and substituting in (4) we have

$R = .28\ G + \frac{1}{4}W + 0.0182\ V$) (5)

(NOTE: .28 becomes .32 for heating to 80° in zero weather or from −10° to 70°.)

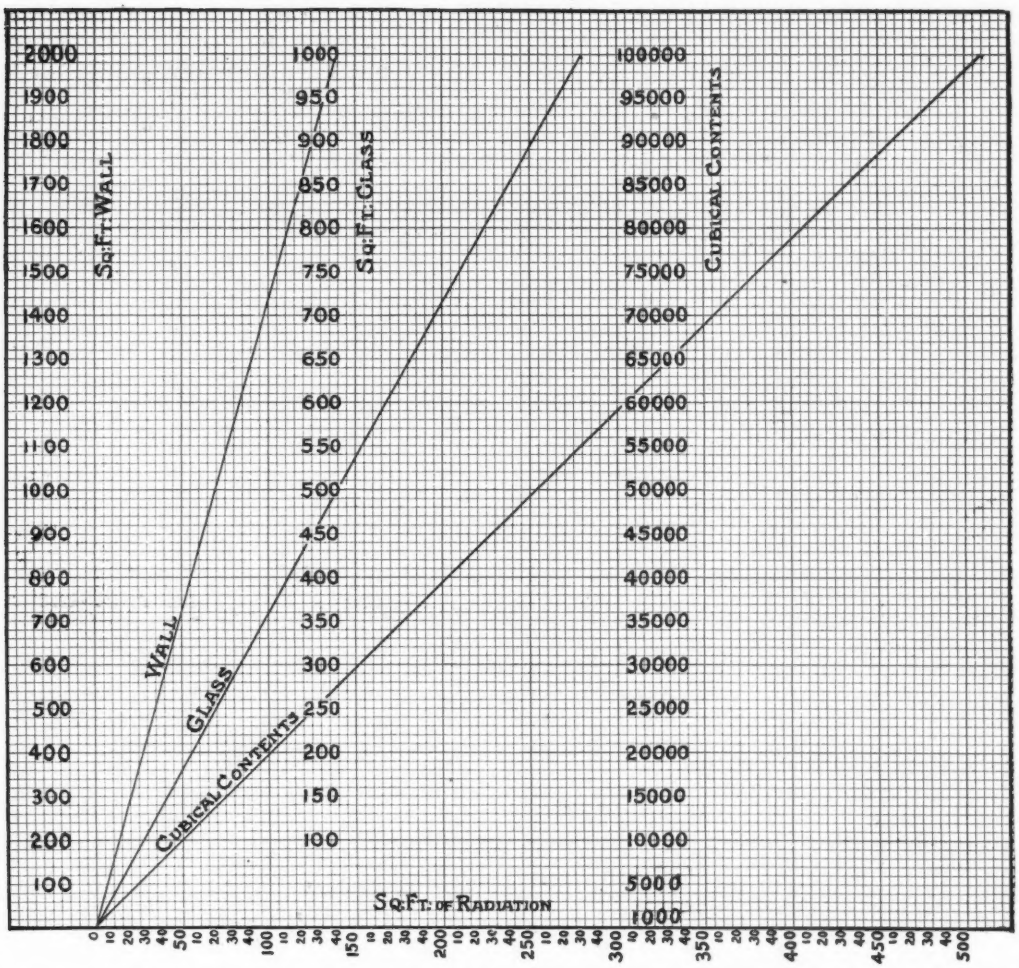
$$R = 0.28\ G + \frac{0.28\ W}{4} + 0.0182\ V \times .28$$

$R = 0.28\ G + 0.7 + 0.005096\ V$

or we can say

$R = .28\ G + .07\ W + .0051\ V$ (6)

For gravity systems of hot water heating, the writer figures 180 degrees for maximum temperature of flow and 145 degrees as temperature of return and hence a mean temperature of 162 degrees.



RADIATION CHART

FOR

SQUARE FEET OF HEATING SURFACE

For Steam Heating from 0° to 70°
For Heating from −10° to 70° add 12%
" " from 0° to 80° add 12%
" " only walls and corridors (0° to 70°) add 50%
" " first floors only add 50% to Cubical Contents
" " by indirect radiation add 50%
" " by direct-indirect add 30%
" " by hot water add 70%

Accordingly we have:

Mean temperature of water....	162°
Temperature of air.....	70°
Difference.....	92°

The amount of heat radiated per degree difference of temperature per square foot per hour for the above water is approximately 1.45 B. T. U.'s.

Hence $92° \times 1.45$ H. U. $= 134$ H. U. given off and we have

$$N = \frac{70}{134} = 0.52 \text{ or say } 0.50 \text{ and}$$

(5) becomes for hot water heating:

$R = .50\ (G + \frac{1}{4}W + 0.0182\ V)$ (7)

$R = 0.5\ G + 0.125\ W + 0.0091\ V$ (8)

which shows that between seventy and eighty per cent. more radiating surface is required for gravity hot water heating than for low pressure steam.

In a forced circulation of hot water, under pressure, and frequently employed in central station work, we can obtain a higher mean temperature in the mains.

The flow can be figured as high as 180 with 160 degrees being returned to the pumps; this will give a mean temperature of 170 degrees. The difference between this and temperature of air at 70 degrees is 100, which, multiplied by 1.5, the number of heat units radiated per square foot of surface per hour, gives a total of 150 heat units. And we have, 70 degrees temperature of room divided by 150 gives us 0.46, whence equation (5) becomes:

$R = 0.46\ (G + \frac{1}{4}\ W + 0.0182\ V)$

$= 0.46\ G + 0.115\ W + 0.00837\ V$ (9)

To compare all of the above formulæ (A to H inclusive) for steam heating, let us assume a room say in the southeast corner of a building having two walls exposed, containing four windows.

Net glass surface exposed = 128 sq. ft.
Net wall surface exposed = 472 sq. ft.
Cubical contents of room, or V, = 7200 sq. ft.

(1) By Mill's formula:

$R = 0.5 \times 128 + 0.05 \times 472 + 0.005 \times 7200 = 64 + 23.6 + 36 = 123.6$ sq. ft.

(2) By Willetts' formulæ:

$R = 0.48 \times 128 + 0.08 \times 472 + 0.002 \times 7200 = 61.44 + 37.76 + 14.40 = 113.6$ sq. ft.

(3) By Monroe's formula:

$R = 0.42 \times 128 + 0.08 \times 472 + 0.0026 \times 7200 = 53.76 + 37.76 + 18.72 = 110.24$ sq. ft.

(4) By Carpenter's formula:

$R = 0.324 \times 0.08 + 472 + 0.006 \times 7200 = 41.47 + 37.76 + 43.20 = 122.43$ sq. ft.

(5) By Lawler's formula:

$R = 0.332 \times 128 + 0.0332 \times 472 + 0.01 \times 7200 = 42.49 + 15.67 + 7200 = 130.16$ sq. ft.

(6) By Babcock & Wilcox's formula:

$R = 0.49 \times 128 + 0.0245 \times 472 + 0.0081 \times 7200 = 62.72 + 11.56 + 58.32 = 132.60$ sq. ft.

(7) By the writer's formula:

$R = 0.28 \times 128 + 0.07 \times 472 + 0.0051 \times 7200 = 35.84 + 33.04 + 36.72 = 105.60$ sq. ft.

Averaging all of the above results would give a radiating surface of 119.74 sq. ft.

The average radiating surface allowed for glass is 51.67 sq. ft.

The average radiating surface allowed for wall is 28.16 sq. ft.

For ventilation the average surface allowed is 39.90 sq. ft.

Now by inspecting the amount of radiating surface allowed by the different formulæ for the air of ventilation and knowing that one heat until will warm 55 cu. ft. of air one degree, we can by deduction ascertain the amount of air allowed per hour or the hourly air change. Whence we obtain the following:

Formula	
(1)	Air figured on as changed every 60 minutes.
(2)	Air figured on as changed every 153 minutes.
(3)	Air figured on as changed every 117 minutes.
(4)	Air figured on as changed every 51 minutes.
(5)	Air figured on as changed every 30 minutes.
(6)	Air figured on as changed every 38 minutes.
(7)	Air figured on as changed every 60 minutes.

which give an average air change once every seventy-two minutes.

CHART

From the formula used by the writer, a radiation chart has been made. By referring to this chart it will be found that the abscissae repre-

sent the square feet of radiation from 0 up to 500.

The values of the cubical contents, the glass surface and the wall surface are represented by different ordinates.

The required amounts of radiation are found as follows: From the figure representing the square feet of wall surface in the room under consideration, follow horizontally to the line marked wall, then drop directly to the bottom where will be found the figure showing the proper quantity of radiation. Then do the same with the middle column showing the square feet of glass, then with the right hand column showing cubical contents. The sum of these figures will be the proper quantity of radiation for the room

Culture in Business Education; and Brains in Colleges

"As between the position of Lowell, who declared that a university should be a place where nothing useful is taught, and the position of a modern educator who declares that the great university of the future will be a perfectly equipped workshop, there seems," writes President Albert B. Storms, of Iowa College, to *American Industries*, "to be 'a great gulf fixed.' Both positions have something to be said in their favor, but it appears to me to be absurd to put culture and business training thus in absolute opposition. They are not necessarily so in education any more than in life. A business training and a classical course in a college or university have entirely different ends in view, and each is legitimate for its own purpose. The cultural value of a business course is incidental; the practical value of a classical education is incidental. All the higher interests of society and state, however, are dependent upon material prosperity.

"The competition between nations and races is rapidly becoming a competition of brain power, rather than of sea power or of military power. Other things being equal, the people that are most skilful, most able to use to advantage their resources, most alert to take advantage of inventions and discoveries, least wasteful of force, will be most successful in national competition. Business colleges and schools should be maintained with a high standard of requirements as to the discipline given and the results obtained. It should never be supposed, however, that such colleges or schools are to be a substitute for colleges and schools of classical and general culture. Such colleges should enable their graduates to adapt themselves to the world's work, and to be themselves efficient workers. Such an education—a business education—may leave men narrow, but certainly should not leave them any narrower than they would have been without it. There is an educational value in learning methods of business, and in the application of thought to the problems that are called practical, and there is an incalculable value in lifting labor of all kinds above drudgery, and of giving a keen intellectual zest to one's business or work, whatever it is, and this a business education helps to do.

"With the efficiency and the happiness and the general welfare of its people, any government should be deeply concerned. Whatever can promote these ends, in equity to all interests involved, is not only legitimate, but desirable."

Church Heating and Ventilation

The ventilation of churches in which the worshippers are packed with a minimum of floor space, for which no excess of height can compensate, is notoriously defective, and, indeed, is worse in proportion to the thoroughness of the heating, since the higher the temperature within the building the more carefully are cold draughts excluded. One of the most interesting systems of combined church warming and ventilation was introduced by a German heating engineer, in a Berlin memorial church that in general plan resembles St. Paul's Cathedral in London, though of smaller dimensions, the height of the nave and

transepts being 82 feet and of the dome 237 feet. The corresponding measurements in St. Paul's are 100 feet and 360 feet respectively. To the height of 80 feet from the floor the walls are traversed by hot air chambers, so that from the ground to the galleries, 22 feet above, there is no perceptible difference of temperature, the air being kept constantly at 60 degrees. The radiating surface is placed high up, in the neighborhood of cooling surfaces, maintaining a higher temperature in the upper portion of the building, and intercepting and reheating the cooled air in its descent toward the lower part occupied by the congregation. There are thus four strata of air of different temperatures. On the ground floor and in the galleries there are very few coils, but along the first entablature, at a height of 95 feet, the coils are sufficiently numerous to counteract the loss of heat through the walls, which there are no longer traversed by hot air channels, and to maintain from this level to that of the second entablature—at a height of 145 feet, or 50 feet above the first—a temperature a few degrees higher than that in the parts below. Other coils are fixed above the second entablature and in the lantern of the dome. To avoid the dangerously chilling draughts that would follow the opening of the doors in the intense cold of a Prussian Winter, the entrances are provided with double swing doors, and coils are placed in the intervening passage. The engineer maintains that the system of heating the upper more than the lower regions of the air is the only proper course in such lofty buildings as churches.—*Plumbers' Review.*

An Invitation to Join the National Association of Master Steam and Hot Water Fitters

The National Association of Master Steam and Hot Water Fitters at this time extends an invitation to all reputable individuals, firms or corporations who are regularly established and engaged in the steam and hot water fitting business to become members of the National Association.

The work and purposes of this Association and the accomplishment of the same were never before so fully realized as they are to-day. At the same time, it is through a fully representative membership that the Association can best attain the benefits it continually seeks for its members. Every worthy new member, therefore, not only places himself in a position to receive the direct advantages that are being enjoyed every day by other members, but also aligns himself for the good of the trade with the only National Association of Master Steam and Hot Water Fitters in the country and one whose membership is notable for its high standard in the business world both financially and as representing the best element in the steam and hot water fitting industry.

At the present time a nominal initiation fee of five dollars ($5.00) is charged by this Association. Where there is a State Association and a Local Association applicants coming within the jurisdiction thereof must first become members of their State and Local Associations before they can become members of the National Association. Where there is no State or Local Association applications can be made direct to National Headquarters, New York, and the information necessary to have in order to properly comply with the requirements will be furnished.—*Official Bulletin.*

Scale or any accumulation of sediment equal to one-sixteenth of an inch, setting on the surface above the fire in a boiler, takes 15 per cent. more fuel than when the boiler is clean, so you want to be careful about recommending a boiler where the circulation is sluggish, or where it is not free and easy.—*From the Model Boiler Free Library, Copyright by the Whitman Co.*

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Foreign countries, - - - - 1.50 " "

IN this issue we begin a series of articles by Dr. Alfred Gradenwitz, one of the best technical writers of Germany.

He starts with the Reck steam heated hot water system which, no doubt, is pretty well known to most of our readers, particularly to the members of the American Society of Heating and Ventilating Engineers, at whose annual meeting in New York last January Captain Reck presented an elaborate description and answered a running fire of questions from the members in attendance.

The next installment of Dr. Gradenwitz's series will be devoted to modifications of this system, or at least systems similar to it, all of them being derived from the invention of the late Frederick Tudor, of Boston.

THE chart for readily figuring radiation, which appears in this paper, is prepared by Mr. J. Byers Holbrook, one of the best young engineers in New York. As is explained by the article which Mr. Holbrook has written accompanying the chart, his ratios vary somewhat from those of other engineers, but whatever ratio may be preferred by the estimator, the chart with such modification as he may wish to make will give him a means of quickly arriving at approximately correct figures; it also furnishes an excellent checking device.

DIRECTORS of corporations who habitually or occasionally pay dividends out of the capital of the corporation instead of from the net earnings, will be interested in the outcome of the case of the stockholders against the directors of the American Malting Co., the decision in which case we give in full on another page.

The law of the state on this subject is very clear. It forbids the granting of dividends except "from the surplus profits arising from the business," and it holds liable, individually and severally, all directors who distribute moneys from any other source than net profits, excepting such directors as may be absent from the meeting where such illegal dividend is declared, or such directors as, being present at the meeting, register a protest against the proceeding.

The New York *Post* suggests that from now on it may be difficult to get a quorum at directors' meetings where the business in hand is voting away capital as dividends. The *Post* also suggests that some companies may be forced to maintain a quorum of under-clerks to vote unearned dividends while the responsible members of the directorate remain discreetly aloof.

THIS decision of Judge Clarke is not a new principle of corporation law, but is simply enforcing one feature of that law in a way that is

unusual, and as it seems to be generally conceded that the decision will be upheld by the Appellate Division of the Supreme Court, the effect will be a case of mingled feelings.

Holders of common stock will feel such a degree of satisfaction as results from confidence that the company's money will stay in the company's treasury until there is an actual net surplus of earned profits; preferred stockholders, on the other hand, will feel less confident about getting dividends if they know that the division of profits depends upon the existence of actual profits.

Of course, the principle involved is not a new one, and we understand that it is one that has been previously agitated but never in so prominent a way, and it has doubtless been overlooked by many who would otherwise have been interested.

More than four years ago a special committee of stockholders of the Malting Company made an investigation and their report sets forth substantially the same facts as those brought out before the Supreme Court, so that the corporation's own records establish the facts and seem to confirm the correctness of this judgment.

In spite of the fact that the Appellate Division has already gone on record as practically saying that the plaintiff had an action in equity, the case will no doubt be carried up on appeal. In that case considerable time will elapse before it can be definitely known that this decision is to stand as a rule for future decisions. In the meantime, however, as the New York *Globe* says, the preliminary decision is sufficient to cause serious thinking on the part of the officials of some of our recently formed industrial combinations. The Malting Company, no doubt, is an extreme instance of the disbursement of profits in excess of what immediate earnings justify. But there have been other companies, and some of them much more important, that would have come within the scope of this strict interpretation of the law. Should Judge Clarke's ruling be upheld it would unquestionably mean a radical revision of the policy of some corporations.

THE last meeting of the British Institution of Heating and Ventilating Engineers, a report of whose proceedings appears in another column, produced a rather more interesting set of papers than has previously been shown.

The excellent paper of the Testing of Large Engineering Plants was written by Mr. A. H. Barker, who is not personally known on this side, but whose personality will readily be identified when we mention that he is connected with the firm of C. N. Haden & Sons, Trowbridge, England. Most of us remember last year's visit to this country of Mr. W. Nelson Haden of that company.

ENGLISH engineers and manufacturers are becoming excited over the question of adopting the metric system of weights and measures. A society has been formed to advocate the system, and, if possible, secure its official adoption. This is opposed by those who prefer to stick to the old British tables and also by a new element favoring a metric system with the meter left out—properly speaking, a decimal system with the inch as the unit.

Perhaps this might be the best so-

lution, as everybody would start with a pretty clear comprehension of what is meant by a tenth or five-tenths of an inch, or 10, 20, 50 or 100 inches. Those figures would give a pretty close idea of measurement without converting them into feet.

As is customary in such cases, the opposing parties or their representatives are writing pamphlets at and about each other and altogether working up considerable feeling.

It will be recalled that in this country the suggestion of adopting the metric system has been unfavorably reported upon by a number of societies, including the American Society of Mechanical Engineers and the American Society of Heating and Ventilating Engineers. Dean Kent, of Smith College of Syracuse University, spent much time on the matter and reported that he considered the metric system not available in this country.

One of the most difficult things to change would be the measure of land, as ownership in land is recorded and titles shown by long lines of deeds, all of which would have to be convert-into whatever new measurement tables might be adopted. Another thing that would create even more difficulty at first, and entail enormous expense, would be the changing of machinery figures where articles are made to gauges. Patterns would become obselete and have to be replaced with new ones while the old patterns would have to be held an indefinite time for the purpose of making repairs.

On the whole, we imagine that the English engineers will arrive at about the same conclusion as our own and let the existing tables stand—even with the pounds, shillings and pence, the stones and quarters, and a lot of other things which do not affect us on this side. Perhaps the weights and measures will be overhauled at about the same time as our spelling and pronunciation, which probably will not be during this administration.

At the same time we must all look with longing eyes upon a system of weights and measures as simple as our currency system—also upon that other pleasing dream, a phonetic spelling which would let us forget the spelling book.

NEW DEVICES

An Automatic Electric Pump and Receiver

The illustration shows a motor-driven, triplex, boiler-feed pump and receiver with automatic switches and motor starter for automatically draining heating systems and factory apparatus which depends upon a free circulation of steam for their efficiency. By doing this it serves a double purpose; first, it automatically relieves the system of the water of condensation constantly collecting therein, thus insuring a free and unobstructed circulation and incidentally preventing snapping and hammering in the piping, which is in many cases due to entrained water; and secondly, it automatically delivers this water directly to the boilers without the intervention of tanks or other commonly used devices. Not only does it relieve the system of a troublesome factor, but it introduces a supply of feed water into the boiler at a temperature impossible otherwise without the use of a special water heater. In modern hotels and apartment houses there is a great demand that machinery should operate with the least possible noise. One of the greatest annoyances is water hammer in the pipes reaching to every part of the building, but by the use of this pumping outfit such noise is entirely eliminated.

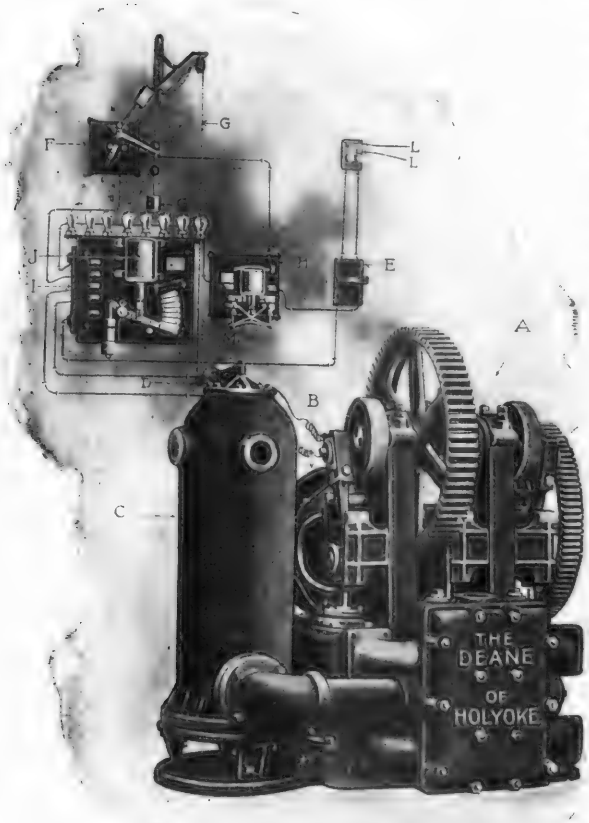
Electric pumps can be installed in locations to which it is impossible to carry any other motive power, and as this pump, by reason of its automatic control, runs only when occasion demands, no special attendance is necessary and the total cost of operation is for current actually used.

The following description will make the action of the apparatus plain:

A is the pump, *B* the motor, *C* the receiver and *D* a lever, operated by a pail float within the receiver, which rises and falls as the water level changes. *E* is the main-line switch, which operates by hand

and is used to cut out the line when necessary. *F* is a switch operated by the float in the receiver through the chain and counter-weight *G*. *H* is the automatic switch which admits current to the motor starter *I* when the switch *F* is thrown in by action of the float. *I* is the motor starter which delivers current gradually to the motor and is operated through the solenoid *J*. *K* is the fuse block and *L*, the line wires.

The switch *E* being closed, water in the receiver rises and throws in the float switch *F*, thereby turning the current



ELECTRIC PUMP AND RECEIVER

through the automatic switch *H*, which in turn delivers it to the solenoid *J*, thus gradually pulling up the lever *I* and gently starting the pump. As the water is pumped out and the float falls, the operation is reversed and the pump stops.

The cut shows the standard type of double-acting pump and receiver with electrical connections and motor, as usually installed. The pump may be either single-acting or double-acting, as desired, the arrangement in either case being the same. The receiver is of the vertical form and consists of a cylindrical closed chamber or tank mounted on a bed plate secured to the base of the pump, so that the apparatus is compact and self-contained. An opening at the bottom of the receiver is provided with a pipe connection to the suction of the pump, and the water of condensation flows into the receiver through the inlets shown near the top. Three separate inlets are provided for convenience in connecting the returns. The receiver float is of a patented type and is a simple pail open at the top and hung from a lever having a counterweight so placed as to overbalance the weight of the pail. The pail is kept filled with water and when the receiver is empty the weight of this water causes the pail to hang in its lowest position. As soon as the water rises in the receiver above the pail the weight of the float is immediately reduced to the mere weight of the pail and the counterweight causes the pail to rise to its highest position and to throw the float switch F to start the pump. This style of float is very simple in construction, sensitive in operation and has none of the objectionable features of the closed or ball float. The float is so guided as to hang in the center of the receiver without swinging and the receiver inlets are provided with hoods to prevent the entering water from interfering with the action of the float.

The K. M. C. Automatic Air Valve

The automatic air valve which we illustrate herewith is known as the K. M. C. No. 6L. This valve is an entirely new construction in several respects; it is thoroughly reinforced throughout, has no soldered joints and it is made of fine brass heavily nickel plated and highly finished.

The key arrangement is such as to prevent its being tampered with by unauthorized persons and it has also an even and accurate adjustment.

As will be noticed by the illustration, the valve works both by expansion and flotation; it will also be noticed that the stem is provided with two passages, one for the entrance of the steam from the radiator, terminating in an opening into the valve just at the bottom of the center post, while the other serves as an exhaust for the condensed steam from the opening of the other side of the post and thus through a lower passageway back into the radiator. This is a unique and characteristic feature of this valve.

The center post is made of a special compound, highly sensitive to the action of heat so that it quickly closes the valve by expansion, forcing the pin at the top into the upper opening of the valve, thus closing it against the outside air.

The float also, when operated, has the effect of raising the pin and closing the top opening, preventing the discharge of air.

The manufacturers give the remarkable

guarantee of five years, which they expect to be rather startling, but state that they will stand back of it. They advise us also that they are having an unprecedented sale of this valve, as they have come into an immediate popularity with the steamfitters from the very first day they were put on the market.

K-M-C AIR VALVE

These valves are manufactured by the Kellogg-Mackay-Cameron Company, Lake and Franklin streets, Chicago, who will send prices, discount sheets and any additional particulars required, upon request.

Directors Liable for Corporation Money Spent in Paying Unearned Dividends

Justice Clarke, of the New York Supreme Court, lately rendered a decision to the effect that the directors of the American Malting Co. paid dividends on preferred stock out of the capital instead of net earnings and ruled that each director is individually liable for the amount so paid out.

The judgment rendered, including interest, amounts to more than $1,400,000. That is perhaps the largest individual judgment ever rendered in the courts of this country. The suit is apparently one of Archibald A. Hutchinson and Victor K. McElheny, stockholders, against Alexander M. Curtis, of Buffalo, a director of the American Malting Co. This suit followed the collapse of one against Moore & Schley, the promoters of the company, who were accused of having made a secret profit out of the original stock issue, and the Appellate Division of the Supreme Court held that there had been no secret profit.

Similar suits have been brought against the other directors of the corporation, each of whom is equally liable. They are as follows: Charles M. Warner, Syracuse; Grant B. Schley, Elberton R. Chatman, Geo. F. Neigleieger, Seymour Scott, and Chas. A. Stadler. The following is the decision as rendered:

SUPREME COURT—SPECIAL TERM, PART V
BY CLARKE, J.

Hutchinson vs. Curtiss—The American Malting Company was organized under the laws of New Jersey, September 28, 1897. It began business on October 11, 1897. On October 15, 1897, it filed a copy of its charter in the office of the Secretary of the State of New York to enable it to do business in this State and received the usual certificate for that purpose. The principal office of the company was situated in the City of New York, at No. 80 Broadway, from its organization until the fall of 1899, and since then it has been situated continuously at East River and Sixty-third street, New York city. The company has had no plant or property in New Jersey. It has kept no bank account there. It had merely a formal, statutory office in that State. Its capital stock is $30,000,000, divided into 300,000 shares of $100 each, of which 144,400 shares of preferred stock and 145,000 shares of common stock have been issued. The preferred stock is 7 per cent. cumulative, having a preference as to dividends only. The company is engaged in the manufacture and sale of malt. Its stock was issued to promoters for twenty-one malting establishments, situated in various parts of the United States, on which they had acquired options, and for $2,080,000 cash working capital. No stock in trade was, however, acquired by the issue of stock. As soon as the organization was effected the company was compelled to purchase from the venders of the various malting plants their stocks of barley and malt, for which the company issued its obligations, amounting to upwards of $1,600,000. A little over two months after the company began business, and on December 20, 1897, the board of directors declared a dividend of 1¾ per cent. to preferred stockholders, payable January 15, 1898. This amounted to $219,450. Thereafter a dividend at the same rate was declared and made payable at each of the following dates: April 15, 1898, $219,450; July 15, 1898, $219,450; October 15, 1898, $219,450; January 15, 1899, $219,450; April 15, 1899, $252,700; July 15, 1899, $252,700; October 15, 1899, $252,700. In all $1,855,350. Barely two weeks after the payment of the dividend of October 15, 1899, and on November 2, 1899, the minutes of the board of directors disclose its serious financial condition as reported to said board, viz., its outstanding obli-

gations amounted to $2,800,000 in notes; that the officers were unable to negotiate further temporary loans; that the company needed additional working capital, and that the board authorized the sale of $4,000,000 mortgage bonds of the company. Said bonds, 6 per cent. 15-year gold mortgage bonds, were subsequently disposed of at a discount of $400,000. This is an action brought by plaintiffs as stockholders on behalf of themselves and all other stockholders similarly situated against the defendant Curtiss as director of the company to compel him to account for and pay to the company the amount of the dividends declared and paid as not having been paid out of the profits, but out of the capital. The board of directors having upon demand refused or neglected to bring suit in the name of the company, it was joined as a party defendant. At first the company put in a defense, but subsequently, its management having changed, it obtained leave to file an amended answer admitting the allegations of the complaint and joining in the prayer of the plaintiffs for the relief demanded. In a similar action against another of the directors the complaint was dismissed upon the trial. Upon appeal the Appellate Division reversed that judgment (Hutchinson vs. Stadler, 85 App. Div., 428). That case settled the law for this court to this extent; that an action could be maintained in the courts of this State against a director of a New Jersey corporation to recover the amount of dividends declared in violation of the laws of that State. Two opinions were handed down, in which the learned justices arrived at the conclusion that the action could be maintained upon different grounds. With each of these opinions a justice concurred. The fifth learned justice concurred in the result. I cite this division of opinion because this court is now called upon to apply the law, as laid down with this practical embarrassment, that while it was the unanimous decision that the action could be maintained, yet the difference in the grounds therefor means a difference of hundreds of thousands of dollars in the judgment I am about to order. As I interpret it that case holds this court has jurisdiction, because section 23 of the Stock Corporation Law of this State provides: "The directors of a stock corporation shall not make dividends, except from the surplus profits arising from the business of such corporation; nor divide, withdraw or in any way pay to the stockholders, or any of them, any part of the capital of such corporation, or reduce its capital stock, except as authorized by law. In case of any violation of the provisions of this section the directors under whose administration the same may have happened, except those who may have caused their dissent therefrom to be entered at large upon the minutes of such directors at the time, or were not present when the same happened, shall jointly and severally be liable to such corporation and to the creditors thereof to the full amount of the capital of such corporation so divided, withdrawn, paid out or reduced;" and because section 30 of the General Corporation Law of New Jersey provides: "No corporation shall make dividends, except from the surplus or net profits arising from its business, nor divide, withdraw or in any way pay to the stockholders, or any of them, any part of the capital stock, or reduce its capital stock, except according to this act, and in any case of any violation of any provision of this section the directors under whose administration the same may happen shall be jointly and severally liable at any time within six years after paying such dividends to the corporation and to its creditors in the event of its dissolution or its insolvency to the full amount of the dividends made or capital stock so divided, withdrawn, paid out or reduced, with interest on the same from the time such liability occurred; provided that any director who may have been absent when the same was done, or who may have dissented from the act or resolution by which the same was done, may exonerate himself from such liability by causing his dissent to be entered at large on the minutes of the directors at the time the same was done, or forthwith after he shall have notice of the same, and by causing a true copy of said dissent to be published within two weeks after the same shall have been so entered in a newspaper published in the county where the corporation has its principal office;" and because section 60 of the Stock Corporation Law of this State provides: "Except as otherwise provided in this chapter, the officers, directors and stockholders of a foreign stock corporation transacting business in this State, except moneyed and railroad corporations, shall be liable under the provisions of this chapter in the same manner and to the same extent as the officers, directors and stockholders of a domestic corporation for: 1st. The making of unauthorized dividends . . . Such liabilities may be enforced in the courts of this State in the same manner as similar liabilities imposed by law upon the officers, directors and stockholders of domestic corporations." That is, by virtue of the statutes, this State allows the recovery of dividends unauthorized by the State of New Jersey from directors of a New Jersey corporation in the same manner and to the same extent as the directors of a domestic corporation. That is, it is the New Jersey statute which makes the dividend unauthorized, but the recovery is to be had according to the New York statute. What, then, is unauthorized? "No corporation shall make dividends except from the surplus or net profits arising from its business." Net profits are

defined in the Century Dictionary as "what remains as the clear gain of any business after deducting the capital invested in the business, the expenses incurred in its management and the losses sustained by its operation." And the controlling question of fact is, Were these dividends paid from "net profits?" The twenty-one branches, located in many places and in different States, which were actually engaged in the business of manufacturing the malt from the barley, sent in to the general office in New York daily, weekly and monthly statements in great detail of their business. From these statements branch books were made and from these a general set of books was prepared. All of the books and papers from the general office, which were used in the accounting department, were produced in court, identified and marked in evidence. The defendant objects to the summaries made up from these books and from any and all conclusions of fact to be drawn from said books and said summaries upon the ground that concededly the contracts and the contract books were not produced and were not considered. It was in evidence that malt was always oversold, that contracts for future deliveries, running over many months, were entered into, and the claim is that such contracts were required to be taken into consideration when it came to be determined whether any particular dividend was warranted or not. Such claim, in my opinion, is unfounded. The law is that "No corporation shall make dividends except from the surplus or net profits." These contracts were to deliver at a future time a product not yet made from raw material, not yet purchased, with the aid of labor not yet expended. The price agreed to be paid at that future time had to cover all the possible contingencies of the market in the meanwhile, and might show a profit, and ran the chance of showing a loss. When the sales actually took place they were entered in the books. But to calculate months in advance on the result of the future transactions, and on such calculations to declare dividends, was to base such dividends on paper profits—hoped for profits, future profits—and not upon the surplus or net profits required by law. It does not seem to me that you can "divide," that is, make a dividend of a hope based on an expectation of a future delivery at a favorable price of what is not yet in existence, under the statute. So the objection to the books upon that ground is of no weight. From the books certain statements were made up for the aid of the court upon different theories and in different ways. One set of statements was testified to be exactly what the books showed, without the change of a figure. These exhibits are known as 10 P, 10 Q. As to these statements I do not understand that there is any controversy as to the accuracy of the figures. A second statement, known as 10 R, 10 S, is identical with the foregoing, with the elimination of one entry, which, as matter of fact, was eliminated by the company itself some months after its entry. There was entered on the books on the 31st of December, 1898, an item of $388,063.36 of the anticipated or estimated future profits on contracts for future deliveries running over many months. This entry, for the reasons stated in regard to the contracts for future deliveries, was unjustifiable. The company subsequently removed this entry. The actual transactions, that is, the deliveries of the malt called for by the contracts and the receipts in payment therefor being reported from time to time as they occurred, resulting in double credits, the cancellation or reversal of the entry was absolutely required. On the other hand, I find against the plaintiffs in regard to their contention as to the increase account. Barley is bought by the bushel of 48 pounds. Malt, the manufactured article made from barley by steeping, is dealt in by the bushel of 34 pounds. The process of manufacture produces 15 per cent. more of malt by the bushel than the barley measures from which it is produced. The amount of this 15 per cent. excess is reported from each of the manufactories month by month as increase. Of course, this increase has a value, as it is sold as malt at malt prices. For the purpose of inventory the company has ascribed to it the value of the barley. This, plaintiffs claim, is error, because that amount has already once been charged to malt account, and they say this increase should have no value ascribed to it until sold and delivered, when its proceeds go into the books as cash. But it certainly is an asset of the company, and as an asset at inventory periods, or when it is necessary to ascertain the actual condition of the company, it must be valued in some way. As it has always been the custom in the malting business to treat it as treated by this company, I am unwilling to disregard that custom. The accounts upon which I based my conclusions treated it as the company did. I find that at the time of the declaration and payment of the third dividend, July, 1898, a deficit was caused thereby of $142,774.59, and from that time to the end of the period under consideration none of the dividends were paid out of net profits, but all were paid out of capital. But it appears that defendant, Curtiss, was not present at the meeting on February 28, 1899, when the dividend paid April 15, 1899, was authorized. Under the New York statute—under which we are proceeding—a director who was not present when the dividend was declared is not liable. The approval of the minutes at the following June meeting, at which he was present, was only the authentication of the proof of what had happened at the previous meeting.

He is, therefore, not to be held liable for that dividend. He is liable, in my judgment, as follows: For dividends paid July 15, 1898, to the extent of $142,774.59; October 15, 1898, $219,450; January 15, 1899, $219,450; July 15, 1899, $252,700; October 15, 1899, $252,700—$1,087,074.59, with interest thereon from the several dates of payment. As the highest court of New Jersey, interpreting the law of the State under which this company was incorporated, held, "for the full protection of the company the liability of the directors must be absolute" (Appleton v. Am. Malting Co.,), I find against the defendant upon his claim that the accrued profits of the company, made under a changed management, can be credited in his favor against his liability. It is claimed that this is a harsh law. If it were such complaint should be made to the Legislature and not to the court. It does not seem to me that in these days of great corporations and of combinations into one of many corporations it is asking too much of directors, fiduciary officers as they are, that they should obey the law of their incorporation and not bring their companies to the verge of bankruptcy and ruin by the payment of quarterly dividends in preferred stock out of capital instead of net earnings. As to the second cause of action: While the allegations are profuse as to a "willful, fraudulent and illegal conspiracy," the proof failed to establish that there was any such conspiracy for defendant's personal benefit. The cases establishing the cause of action pointed at in these allegations have been where directors have diverted to themselves for their own benefit the property of the company. The damage here flowed out of the making of the dividends, if any there was. It was alleged that the company had to issue bonds, and that the commissions, discounts and interest thereon amount to $650,000, which, as a waste of its funds, the plaintiff seeks to recover. But as I find that this flowed as a damage only from the declaration and payment of the dividends, I am persuaded by the language of Mr. Justice Hatch in Hutchinson v. Stadler (supra) that it does not under the facts of this case constitute a separate cause of action. He says: "In point of fact the statute of the State of New Jersey upon this subject, as well as our own, does little more than lay down a rule of damage to be enforced against directors for breach of duty. At common law a recovery could be had for the waste, but the extent of the recovery would depend upon the damage sustained by the corporation and be the subject of proof. The statute measures the loss sustained, which is usually the correct amount, and authorizes a recovery therefor of the individuals who produced that result." It seems to me that any other theory would result in turning the amount recovered for illegal dividends into a penalty. The Court of Errors and Appeals of New Jersey in this very matter, as well as our Appellate Division, have held: "The liability imposed by the statute is not penal in its character. Its sole purpose is not to punish, but to provide for the making of compensation by wrongdoers for the injury sustained by their wrongful act." This alleged loss must, therefore, be held to have been included in that for which the defendant is required to make compensation by paying into the company an amount equal to the illegal dividends. Judgment for the plaintiff as indicated, with costs and extra allowance of $2,000.

British Institution of Heating and Ventilating Engineers

The annual meeting of the Institution of Heating and Ventilating Engineers of Great Britain was held at the Holborn Restaurant, London, October 18. The meeting was called to order by President L. F. Pearson, the folowing members being present: Secretary, E. Taylor; Treasurer, F. Taylor, and Messrs. A. H. Baker, A. Blackman, J. E. Boaz, F. W. Briggs, A. Burgess, W. J. Burroughes, G. Crispin, T. F. Dredge, A. J. Duffield, A. Foppes, W. Freer, T. Frewin, K. Gray, H. H. Grundy, C. I. Haden, W. N. Haden, S. E. Haward, E. J. Jenkins, W. Jones, S. L. Kilpin, D. M. King, J. Lambert, F. Lange, J. Legg, W. Lohr, W. Macintosh, C. Mason, W. Mayner, F. Milan, J. F. Newman, J. S. Palmer, L. F. Pearson, A. B. Potterton, T. E. C. Potterton, T. Potterton, W. Radcliffe, G. Ray, J. A. Riley, G. W. Robinson, J. L. Saunders, A. B. Simpson, A. Taylor, A. E. Thomas, W. G. Tolley, C. T. O. Trotman, J. W. Wagsteff, W. H. Warren, H. W. Waudby, W. Yates and W. A. Young.

The following new members and associates were elected: J. A. Dargue, Liverpool; T. F. Dredge, London; J. W. Gibbs, Liverpool; F. H. Horton, London; John King, Liverpool; R. E. Marshall, Cheltenham; William Matthews, Manchester; J. M. Saunders, Manchester, and J. W. Stevens, Birmingham. Associate, C. D. Pearson, Shanghai.

Mr. George Crispin, Bristol, was elected President for 1905 on the recommendation of the Council and on the motion of Louis F. Pearson, seconded by Mr. W. F. Jones.

Mr. W. H. Grundy read the following paper on

THE WARMING OF PUBLIC BUILDINGS BY THE WARM AIR SYSTEM, CONSIDERED FROM A HYGIENIC POINT OF VIEW

I have been induced to so entitle my paper partly for the reason that a great misconception appears to exist as to the scientific application of that system. I refer

particularly to the natural or gravity system which has been condemned by several engineers, who have, I feel sure, never gone carefully enough into the technicalities of the subject. But a second reason why I venture to deal with this subject is that I have myself carefully observed a great many heating installations which have been carried out, where the one and only consideration appears to have been the raising of the temperature in some cases even to an abnormal extent without any thought as to the change of air necessary to render the space treated habitable.

I refer more particularly to installations which have been erected by persons who have had imperfect knowledge of the subject, and who, although calling themselves heating and ventilating engineers, should no more be allowed to carry out their pernicious practices than a so-called physician without a degree. I do not think I am using language too strong when the matter is carefully considered, and am of the opinion that the Government (which looks after the adulteration of food, drink and sanitation to some extent) should not allow haphazard schemes to be applied to any building occupied by a number of people.

The remedy would, no doubt, form matter for lengthy discussion, so I will return to my subject, dwelling first of all upon the greatest of all necessaries—the supply of large volume of fresh, pure air wherever any body of persons is gathered together. Admitting that a great number of heating and ventilating installations are very far from satisfactory, in fact in some cases positively dangerous, it behooves us to look carefully into the subject and see how far we can go to remedy the defects. Progress has, however, in a great measure, been barred wherever the engineer has proposed dispensing with the open fireplace. While being quite aware that this does not apply very forcibly in many public buildings, excepting, perhaps, schools and hospitals, there is a general prejudice against their removal. This, fortunately, is now being overcome to some extent, as it is found that there are systems whereby the temperature throughout a building is capable of being maintained at an equable and agreeable degree, with a total absence of cold draughts, and which at the same time are satisfactory alike from an economical, a hygienic and a scientific point of view.

The great importance is acknowledged now of the combination of ventilation with every heating system, and, in fact, no heating apparatus can be considered complete which does not combine with a system of ventilation. Unfortunately, it has been proved over and over again that very few buildings have been provided with satisfactory means of ventilation, and that however well the heating may have been carried out and its capabilities of maintaining, perhaps, a high temperature in the coldest weather tested, in very few cases is the question of adequate air supply taken into consideration.

In some cases buildings are fitted up with most elaborate mechanical appliances with this end in view, but often the question of expense arises which at once precludes their use, however perfect they may be. Such plant generally requires the entire attention of a qualified engineer, and is only practicable in remote cases. Therefore, in designing an installation for effectually warming and ventilating a building the first thing to be remembered is that it shall work automatically, and the movement of the air be brought about by the simple action of chimneys or flues. The necessity for change of air is rendered evident when we consider the multitudinous causes of vitiation. The principal one is that caused by respiration, and which operates within the building to be ventilated.

It is, of course, common knowledge that we breathe enormous quantities of air, and that as it returns from our lungs the proportions of the gases which constitute it are altered; the oxygen being reduced and the carbonic acid increased. This, however, is not the greatest mischief, and does not account for all the bad effects.

The question to be asked is, How, then, does all the mischief of inhaling this air arise? The truth is, that in taking air into our lungs and breathing it out again, we breathe out with it an organic poison, and although little is known about its nature there is no doubt as to its poisonous properties. Dr. Ransome says of it: "The aqueous vapor arising from the breath, and from the general surface of the body, contains a minute proportion of animal refuse matter which has been proved by actual experiment to be a deadly poison." It is this substance that gives the peculiar close, unpleasant smell which is perceived on leaving the fresh air and entering a confined space occupied by human beings or other animals. Air thus charged has been fully proved to be the great cause of scrofulous or tubercular diseases, and it is the home and nourisher of those subtle microscopic forms of life that have lately become so well known under the title of germs of disease, or microzyms. It is probably the source of a large part of the increase of mortality that seems inevitably to follow the crowding together of the inhabitants of towns.

Again, whatever degree of dryness the air may possess previous to inspiration, after expiration it is saturated by vapor, the quantity which will be thrown into the atmosphere depending very greatly upon the individual and the season. The composition of the air is altered also by the production of carbonic acid from the lights. This may also be described as an action from within. Added to this, ex-

ternal causes of vitiation should also be taken into consideration in designing an effective system of ventilation. The chief of these are the solid products of combustion discharged from chimneys and the decomposition of animal matter. In the country this is not to be taken into such serious consideration, but in large towns where these causes of vitiation chiefly exist careful consideration should be given.

This aspect of the subject has had little thought bestowed upon it, and where a certain quantity of air per capita has been specified, the same amount has been demanded for country as for towns. The main object of ventilation, therefore, is to cause a constant renewal of the air, and this is doubly necessary in the case of all public buildings, where the causes of vitiation are enormously intensified, especially in the cases of hospitals and schools. To determine what method should be adopted demands now the skill of the engineer. Being aware of the fact that air must be moved in such quantities as to cause this constant renewal, it now resolves itself into the question of the best method for its accomplishment and the quantity to be introduced.

It has been found by careful tests that the organic matter due to exhalations from the breath increases directly, as the carbonic acid increases; therefore, by simple tests, we can calculate the quantity of fresh air required to be introduced to keep the air inside within the limits of good ventilation, bearing in mind that in a climate so variable as ours this interchange of air must take place without creating unpleasant draughts or discomfort to the occupants.

It has been proved by the most exhaustive tests that the quantity of fresh air to be admitted should in no case be less than 20 cubic feet per minute, or 1,200 subic feet per hour per head of inmates in ordinary good health. In school buildings this should be increased to 1,800 cubic feet, and in hospitals and infirmary wards to between 4,000 and 6,000 cubic feet, in order to prevent any undue accumulation of the impurities of respiration and to avoid disagreeable draughts.

It is now proposed to show how an apparatus can be installed to cope with this quantity of air supply, and as an example I will take a school building containing six class-rooms and one central hall on the ground floor, and six class-rooms and one central hall on the first floor. It is proposed that each class-room shall be occupied by 50 children of varying ages, and that each child shall be supplied directly, by means of the heating apparatus, with 30 cubic feet of fresh temperately warmed air per minute. This is exclusive of additional inlets introducing cold air direct from outside to obviate the necessity of opening windows during cold weather.

To introduce this quantity of air has proved the stumbling block to many engineers and especially those who have attempted its accomplishment in conjunction with direct systems of heating. As pointed out in the early part of this paper, it is an extremely simple matter to easily accomplish the raising of the temperature in a confined space from, say, 25 degs. Fahr. outside to 60 degs. Fahr. inside (the usual school standard); but to do this with direct radiating surfaces, and at the same time to insure efficient ventilation, has generally resulted in failure. Innumerable instances are to be found where a most efficient heating apparatus has been installed which warms the space (generally ly speaking using low-pressure hot water and direct raidators and pipes as the medium), but where cold air is admitted in a most haphazard way; and as a criterion to its effectiveness, the cold air inlets are invariably blocked up, as neither children nor teacher can tolerate the insufferable draughts produced. Added to this, in nine cases out of ten the exhaust air flues (if any) are totally inadequate to carry off the vitiated air.

The consequence is not far to seek. Complaints are made as to the stuffy condition of the atmosphere, the teacher's temper is not improved, and the children are listless and inattentive. In order to partially remedy this evil the windows are constantly thrown open, with the result that the temperature is continually being lowered and raised, causing bad colds and coughs, which could have been prevented had only adequate means been taken to supply the necessary quantity of fresh air, and to provide for its removal after vitiation.

The first essential is, of course, in designing the building to provide a heating chamber of adequate size to contain the apparatus, air storage chamber, filtering apparatus, etc., and at the same time to allow ample provision for stoking space and fuel storage. The access to this chamber should in all cases be directly from the outside of the building, and entered by steps from the playground or other approved position. An onen area, if possible, is advisable, to enable a window to be provided to give good light, and a coal shoot formed to save the necessity of carrying down fuel, etc.

A gulley should be provided to take away the water from the filtering shaft, and pipes run from the shaft and connected with the drain. Where a horizontal smoke flue is necessary across the chamber, it should be constructed of cast-iron, be of ample dimensions, and well provided with doors for the easy removal of soot or other products of combustion.

Immediately below the point where it joins the vertical smoke flue a large cleaning door should be provided to give access for cleaning the latter. The cast-iron pipe should be covered with non-conducting composition. In this particular case a cast-iron heater is proposed

to be used, and will occupy a space of approximately 15 feet by 5 feet, having a heating surface sufficient to economically deal with the volume of air to be warmed.

As there are twelve class rooms, the cubical contents of each being 8,400 cubic feet, and two central halls, each of 25,000 cubic feet capacity, it will be found that, providing for a change of air to meet the necessary requirements of 1,800 cubic feet per head per hour, an apparatus capable of warming 1,080,000 cubic feet per hour is needed for the class-rooms; and allowing for a change of air of twice per hour for central halls, this will add 100,000 cubic feet, making a total of 1,180,000 cubic feet to be dealt with per hour. The type of apparatus used for this purpose is principally composed of secondary heating surface gilled in such a manner as to allow the free passage of air over the whole of the surface, and the firebar area proportioned to prevent the overheating of the same.

I have already referred to the apparatus as being constructed of cast-iron, and at this point would like to deal with an objection often raised as to the dryness of the air produced with cast-iron stove surface. Professor Wolpert proves over and over again in his thesis on warming by heated air that air cannot possibly be dried by any mode of warming, no matter of what material the stove may be constructed, but, on the other hand, air in proportion to the extent to which it is heated will contain a larger amount of water in suspension before it is saturated with moisture.

The same amount of air when saturated with moisture at freezing point will, if raised 10 degs., require a larger amount of moisture to saturate it, and will, therefore, seem to be relatively dry, and it is perfectly immaterial what agent is employed for raising the temperature.

The increased capacity for absorbing moisture possessed by the air will produce its effect, and if no water in a fluid state be present, the air will derive the amount of moisture necessary to saturate itself from any objects that may be subjected to its influence. In order to avoid a relative dryness of the air, it is advisable to provide humidifying apparatus suitable; but this question will be dealt with later.

It has often been advocated that all fireboxes should be lined with firebrick, but when it is carefully considered, the disadvantage of this lies with the formation of carbonic oxide, which reduces the efficiency of the apparatus, since the formation during the process of combustion is always accompanied with loss of heat. Coal, when burnt for producing carbonic acid, generates 8,080 units of heat. When producing carbonic oxide it only generates about 2,450 units or about one-third. This extraordinary diminution of heat generated ought to be easily observed even without the assistance of any instrument, if it took place to any sonsiderable extent.

Professor Meidenger was not able, by thermometric observations, to discover a loss of more than 3 per cent. of heat. but a considerable loss of heat, amounting to more than 12 per cent., was discovered after the iron cylinder was lined with a layer of fireclay about one inch thick. The explanation of this remarkable difference is easy enough directly we consider the conditions under which the combustion takes place and the behavior of the fuel. Carbonic oxide is only formed as a secondary product. Oxygen burnt in contact with carbon produces in the first instance only carbonic acid. The reduction of carbonic acid to carbonic oxide requires the action of a great amount of heat. C with O_2 generates 8,080 units of heat; C_2 with O_2 generates only 4,900. The difference amounts to 3,180 units of heat, and that amount of heat is absorbed in combining CO_2 with C to produce CO. This process requires therefore a very high temperature, otherwise it will not be possible.

Coke is a comparatively good conductor of heat; the heat generated by it during the process of combustion spreads rapidly through the mass and can easily be conducted by an iron shell to its external surface. If this actually takes place, the amount of heat which remains behind and is available for converting carbonic acid into carbonic oxide is only small, hence the amount so reduced cannot be large. But if the firebox be lined with a non-conducting substance like fireclay, then the heat is kept in, and the production of carbonic oxide in large quantities is rendered possible. This result, which was discovered by purely physical observations, was confirmed by a chemical analysis of the products of combustion.

A. Buhe, in an article on "Coke Stoves and the Use of Coke in Them," says: "The lining of stoves with clay in order to prevent the iron from becoming red hot, and thereby to prevent a dreaded diffusion of carbonic oxide throughout the air of the room, must accordingly be looked upon as a most senseless proceeding; in fact, the operation completely fails in its object, as, owing to the products of combustion containing a much larger amount of carbonic oxide, a diffusion of this poisonous gas, if it does not take place from the actual seat of the fire, will take place all the more certainly through the joints of the different parts of the stove, if not hermetically sealed." Many stoves are provided with a special lining which goes down nearly to the firebars in order to fill up the seat of the fire and to confine the actual amount of fuel in process of combustion to a certain narrow zone, in the hope of thereby preventing the formation of carbonic oxide. According to the above explanation this lining can be of only trifling service for such

a purpose. It will only prevent the production of carbonic oxide at a certain rate of combustion unless free oxygen be present. If the draught be strong an excess of air will be present among the products of combustion, and if the draught be weak there will be a small amount of carbonic oxide. This special lining is, therefore, as a rule, worthless, and only makes the stove more expensive and contracts the amount of space available for containing fuel. Moreover, if certain kinds of coal were burnt the lining could not possibly be used.

The use of cast-iron is to be preferred to wrought-iron in construction for the following reasons: The gases of combustion do not attack it so readily; it can be made in sections, which are more easily handled; it does not oxidize so quickly; it can be made with fewer joints and be more easily cleaned; there are no seams to open with continual expansion and contraction. One objection often raised to this system of heating is that the injurious gases of combustion can pass through cast-iron when it is raised to a red heat. But as the draught in a furnace must always be greater than the draught created by air ducts, this statement is ridiculous, and if only the heating surface is properly proportioned to do the work required of it, no overheating is necessary. The chief cause of objection has been due to the fact that hitherto it has been the practice in most warm air installations to over-rate the heating surface and, in order to gain the necessary temperature, it has been compulsory to raise the temperature of the heating surface to a very high degree, while no thought has been expended on the proper provision for cleaning the air chamber or screening the cold air in its passage from the outside to the warm air generating chamber. The consequence has been that innumerable dust particles have been conveyed into it and literally burnt, thus accounting for the so-called parched and unpleasant odor often attributed to the air.

In the majority of cases that have come under observation, it has been found that no inspection door has been provided to give access to the air chamber, and, in consequence, the apparatus has been at work for years until a thick deposit of dust has accumulated on the heating surface, with the result that when warmed it emits an unpleasant smell. We should not think of neglecting to well flush our sanitary appliances at home; why, therefore, do we neglect the all-necessary duty of keeping free from impurity our air supply, which is the breath of life? In the installation I am describing, the air is introduced directly from outside the building by means of air ducts, constructed of either glazed stoneware pipes or brickwork, carefully cemented inside to a smooth face, to afford every facility for a rapid transmission of air, and to minimize friction. Experience has proved that it is advantageous to take these trunks from all sides of a building where practicable, and in an instance such as above quoted to collect them into one common shaft situated so that the cold air supply to the apparatus can be easily effected. In this shaft it is proposed to place three screens of perforated zinc, carried on runners, so that one or all may be removed for cleansing purposes. Taking into consideration the area of the shaft necessary for the supply of air, these screens are so proportioned as to allow the full complement of air to pass. This arrests the passage of the dust particles, and, in the case of town installations, a large quantity of carbon in the form of soot. Added to this it is proposed to install a filtering spray, i. e., in the main cold air shaft a water spray is provided, discharging water in the finest spray, reaching all sides of the shaft. The result is that all dust particles are arrested and thrown down through the agency of the water into the gulley below, and thence conveyed to the drain. Further, the spray discharging downwards partially helps to induce a current of cold air.

While on this subject, it is as well to refer to the proportions of cold air supply to meet the requirements of the warm air ducts. Allowing for a discharge into rooms through warm air registers at the rate of 5 feet per second, and making proper provision for cold air supply, it has been proved that the proportion of cold air, taken on a basis of 32 degs. Fahr., should not be less than 80 per cent. of the total area of outlets. To deal with the necessary volume of air supplied to warm it to its proper temperature and to discharge it into the spaces to be warmed, demands most careful calculation, both with regard to exact areas of ducts and shafts, as also to heating surface in the apparatus. By calculating separately the losses taking place through walls, windows, floors, roofs, doors, etc., and allowing a factor for the different materials, we arrive at the loss of heat throughout the building. Added to this, we have to allow for the loss of heat by the air allowed for ventilation, and this added to the former gives us the total amount of heat required per hour. Knowing the value per square foot of surface in the apparatus, it is easily calculated what number of heat units are required to give the necessary result, and thereby the surface is proportioned.

I have referred before to the air discharged through the registers. This should never be allowed to move more rapidly than 5 feet per second. The question will probably be asked how, in the event of a sudden rise in temperature such as we so often experience in this country, with the apparatus working to give definite results on a lower temperature, is a great increase prevented in the

class-rooms? This is easily accomplished, two methods being employed. All warm air ducts, where they leave the air generating chamber, are formed in duplicate; that is to say, they have a separate opening from the cold air chamber, and are provided with a double swing valve, so that when opened in one direction the cold air is entirely excluded, while it can be so regulated as to admit warm and cold air in any proportion. This is done by the attendant, or by means of thermostats. By this means the temperature of the air may be regulated without affecting (except to the slightest extent) the volume of air delivered.

Having dealt with the necessary heating surface, the source and supply of fresh air, the quantity to be warmed and discharged per hour into the rooms, I now wish to deal with the position and arrangement of the inlet gratings or registers. This is a subject upon which almost endless discussion has taken place, and a great divergence of opinion even now exists among medical and scientific men. The matter being one of such great interest, the writer was induced to make a number of experiments, and arrived at the conclusion that to obtain the most thorough distribution of air throughout the room the inlet should always discharge opposite to the coldest surface.

Taking a room with three inside walls and one outside, the warm air shaft should be constructed in the inside wall opposite the exposed one. In this case the exhaust air shaft should be formed in the same wall adjoining the warm air shaft. In the case of a room having two outside walls the warm air inlet should be situated to discharge from the shaft in the inner wall along one outer wall towards the other outer wall. The exhaust air shaft in this case should be situated in the inner wall at the opposite end. In the case of a room with three exposed walls the positions of warm air inlet and exhaust shafts should be as described for one exposed wall only. It has been the general idea to place the exhaust as far away as possible from the inlet, but practice has proved that this arrangement has not the same beneficial results. In the system described in this paper the warm air is admitted through registers fixed in all cases not less than six feet above the floor line for winter ventilation, a second register being provided in the same shaft near the floor line to admit fresh air for summer ventilation. In the same way two registers are provided in the extract shaft, one near ceiling and one near floor line. In winter time the air is admitted at the higher level, rises to the ceiling, and is distributed in horizontal strata, having practically the same temperature all over the room at the same level. The exhaust register near the floor line is now opened, and by the action of exhaust shaft the air is drawn down, removing all the heavier gases of vitiation by this means.

It follows naturally that if air is admitted at a higher temperature than the gases of respiration these must necessarily fall, and, therefore, the above arrangement has proved the most successful. The advantage is further exemplified by the fact that you are in both cases making use of the vertical column and thereby insuring more constant currents. In summer time the cooler air is introduced near the floor line, and being heavier than the respired air assists in its removal from the top of the room. The question of humidity has now to be gone into, and it is proposed to provide proper apparatus for this purpose in the warm air generating chamber. It has been the common practice to simply suspend a vessel of water of any size without any thought as to the quantity of air to be dealt with, or the percentage of moisture requisite to render the air pleasant. In the installation I am attempting to describe, a vessel is provided of such a form that the surface of the water can be instantly altered by means of a regulator. As the temperature in the air chamber varies with the required conditions, so the water surface is altered to suit, it being well known that evaporation takes place only in accordance with the surface exposed.

I would now like to say a few words on the subject of automatic control of temperature throughout the building. By the means of thermostats this is easily accomplished, and has been found to work with most satisfactory results. The form of thermostat most suitable is that which operates by means of air tubes connected with a metal diaphragm divided into two parts. In one is a liquid which boils at 60 degs. Fahr. When the temperature rises above this point, vapor forms and the diaphragm is expanded, forcing the air on the other side through the air pipe. This operates upon another diaphragm, and, in turn, opens or closes the valve regulating the supply of either warm or cold air.

There only now remains the question of the exhaust air shafts, and these should be arranged in the position as above described. Experience has proved that they should be of the same area as the warm air inlet shafts, and the registers proportioned in accordance. As a still further aid to their efficiency, it is proposed that they should be connected by means of metal ducts in the roofs to one common shaft through which the smoke flue is carried. This will at all times induce an up-current where the apparatus is at work, or in summer time a fire can be arranged at the base to always maintain a temperature which will serve to keep this aspirating shaft at a sufficient heat to insure the quantity of air passing through. A very successful arrangement is to provide a cast-iron flue and to carry it inside a

brickwork shaft of sufficient area to deal with the total area of exhaust ducts.

Unfortunately, time has prevented my going more closely into details with regard to areas, surfaces, etc., but it will afford me great pleasure to make this the subject of a future paper if the foregoing has created any interest among the members. My main aim is, and always will be, to advocate the provision of a proper air supply, which must be temperately warmed before admission, robbed of the greater portion of its impurities, and introduced in such a way as to produce no unpleasant results.

Mr. A. H. Barker read the following paper on

THE TESTING OF LARGE ENGINEERING PLANTS

Having in recent years superintended the testing after completion of many large engineering plants under working conditions, I am glad to have the opportunity of discussing some of the methods adopted, in the hope of eliciting some valuable criticisms from the members of this Institution.

In the first place I should like to refer to the conditions under which these extensive tests are of necessity made, in order to disarm any ultra-scientific criticism. Their object has in all cases been practical rather than scientific. I am almost afraid to make such an explanation as this, being fully aware that the term "practical" used in such a connection is apt to bring a smile to the face of a scientific engineer, for the making of what is commonly called a "practical" test affords an unequaled opportunity for the display of ignorance of the first principles of scientific investigation, of which opportunity full advantage is not infrequently taken.

As a matter of fact, a practical test of any value always involves the most careful observance of these principles to a degree even greater, perhaps, than a purely laboratory test; otherwise the results may be wholly misleading. For in a practical test made under working conditions the factors having a large influence on the result are often very numerous and, unlike those dealt with in a laboratory, impossible to control and difficult to observe with accuracy. The amount of such influence must in all cases be borne in mind by the experimenter, so that to secure practical accuracy and at the same time avoid scientific pedantry is a difficult matter, requiring the exercise of a keen sense of scientific proportion.

In most cases it is necessary that each individual test should extend over at least a whole day, and preferably over several days. As the time available for the whole proceedings, including the not inconsiderable preparations required, is not more than a few days, while the amount of information required from the tests is very large; and as the various parts of the apparatus under observation are often situated hundreds of yards apart—some of it being in subways difficult of access, and some in roofs or at the top of high water towers up 80 feet of stairs—it will be understood that the tests involve not only great physical exertion during whole davs and nights, but also very careful preparation and organization, and much practice in making and recording observations.

The essential value of these tests for practical purposes consists in the fact that they are made while the apparatus is actually in use. The results would be vitiated by any exceptional conditions being introduced. On no account, therefore, must the working of the apparatus be stopped.

In preparing for a large test, the first thing to be done is to design the tests in detail, to decide on the amount of information that can be obtained in the time and with the materials at one's disposal. I have now collected a complete set of testing appliances of things I know will be required, so that the apparatus question is not so difficult as at first. There are always a large number of things which one would like to observe for scientific reasons, but it is imperative to avoid all extraneous considerations, and the results I have always endeavored to obtain are those bearing on economy of working and of first cost.

The apparatus tested includes heating installations, ventilation, hot water service, laundry requirements, kitchen, cold water supply, electric light, engine consumption, boiler feed and fuel consumption, economizer efficiency and other minor matters.

Heating Installations

Speaking generally, a satisfactory test of the adequacy of a heating installation cannot be made in the time at one's disposal. Every heating engineer knows how futile the guarantee clause in a specification generally is. That clause usually specifies that an internal temperature of 60 degrees must be maintained with 30 degrees outside, or something similar. No mention is generally made of the interchange of air nor of other matters equally vital. Indeed, the very text-books on the subject do not recognize the fact that the same degree on two different days, with the same outside temperature and approximately the same interchange of air, will produce a temperature 5 or 6 degrees lower on a rainy day when a gusty east wind is blowing than on a still day; nor that the temperature produced during the second winter of the working of an apparatus is some 3 degrees higher than during the first. Also the same text-books do not mention the fact that the amount of heat obtained from a ventilating radiator depends not only on its temperature, but also, at the same temperature, on the amount of air passing through it, the variation being as much as 70 per cent. in some cases.

It is, therefore, obvious that a test of

internal temperature of one day's duration when the weather is not made to order is perfectly futile as an indication of practical adequacy, and that the only practical criterion of adequacy is a record of temperatures inside and outside throughout an entire winter. One has to recognize that no test is of any scientific nor even of much practical value, unless it can be repeated with approximately the same result at any future date.

Now, a test of internal temperatures could no doubt be repeated if it were possible to get identical weather conditions at some future time, but in practice it is impossible to repeat these conditions. If by some accident the identical conditions were repeated it would almost certainly be on some day when a test could not be made, and even if made the test would hold good only for those precise conditions and no others. Here again the factors bearing on the result are numerous and all but impossible to determine with accuracy, and absolutely impossible to allow for in calculations.

Thus, suppose after the heating apparatus had been six hours at work the temperature in a certain room on a wet day with a 20-knot east wind were 56 degrees, the outside temperature varying from 35 to 40 degrees, who is going to calculate what the temperature would be in that room on a bright, frosty day, in sunshine, in still air, with outside temperature 28 degrees, after a week's continuous work, even though the apparatus were worked to the identical temperature as on on the first day? I do not think the conclusion can be avoided that it is only in rare cases that the performance of an apparatus in respect of internal temperature on any one day is a reliable criterion of its adequacy, and, therefore, in cases where there is plenty of other information to be obtained, only casual observations of the internal temperature need be taken.

The only possible scientific criterion of the power of an apparatus in respect of the internal temperature it would produce in a certain building would, in my judgment, be somewhat as follows: What temperature would ultimately be attained in the building when empty, if an uniform temperature of, say, 32 degrees Fahr. were maintained outside, the air being perfectly still, and the hygrometric conditions constant; the temperature of the radiators being maintained constant for several days by the uniform combustion of fuel at a definite rate per hour in the grate of the boiler, the test to be made after the apparatus has been in regular use for at least one whole winter?

Of course such a clause appearing in a specification would be laughed to scorn—and rightly so, because of the utter impracticability of carrying out the test that it calls for. But the fact remains that any less definite conditions are of necessity scientifically absurd, because in practical use the external temperature, the hygrometric conditions, the direction and force of the wind, the amount of ventilation, the draught in the boiler flue, and, in consequence, the amount of fuel consumed, and the temperature of the radiating surface and other conditions, are continually varying periodically from very low to very high values, all of which factors do undoubtedly exercise a great influence on the resulting internal temperature.

The question, therefore, which heating engineers in practice set themselves to answer is not what is the theoretical value of the conductivity of brickwork or glass and other kindred matters? nor, on the other hand, what is the theoretical emission of heat from radiators? but what amount of heating surface and at what temperature will satisfy people living in this climate? and the scientific aspects of the question and scientifically derived coefficients are only connected with the actual problem in a very rough way as an approximate or proportionate guide.

A practical, scientific engineer takes account of these varying factors by allowing a certain percentage over and above the figures derived from scientific coefficients, and this percentage is derived only from experience, and not in any way from calculations; and this, I think, is the true relation of the scientist and the engineer. It is mere ignorance which makes the practical man scoff at the scientist, and not less ignorance which causes so many of our scientists to scoff at the small mental or scholastic attainments of the engineer. The ideal relation between them is that the scientist furnishes to the engineer the relative values of the various coefficients and the absolute value under certain definitely specified conditions, while the engineer ascertains from practical experience by what percentage the figures furnished by the scientist must be increased or diminished for a practically good result. The consequence is that a heating apparatus which produces results which are in practice up to the client's requirements must be considerably more powerful than a strict reading of a guarantee clause would pronounce to be necessary.

A man who receives from an engineer a guarantee that his apparatus will produce 60 degrees internally with 30 degrees externally, expects, and in my view reasonably expects, to find his thermometer reading somewhere about 60 degrees when he comes down to breakfast on a frosty morning. But he would not be within his rights in expecting that under all possible atmospheric conditions, the outside thermometer not being below 30 degrees, his inside thermometer should show a minimum of 60 degrees, because such a power in the apparatus would be far too great for every-day requirements.

The method, therefore, that I employ in

testing a heating apparatus is to investigate the adequacy of the generator and the correctness of the circulation and the uniformity of the heating effect, relying on previous experience and calculation for adequacy of the heating effect, obtaining also where it is possible a record of the external and internal temperature throughout a winter. The test is commenced with the apparatus cold, and it is set going uniformly. If the generator is a boiler, equal heaps of fuel are thrown into the furnace at measured intervals of time. The weight of fuel thrown on per hour is calculated from the thermal units which the calculation shows will be given off from the radiators and pipes per hour at a mean temperature of 160 degrees, divided by the efficiency of the heater, also derived from previous experiments. Then regular readings are taken off the temperatures in the main flow-pipe and main return-pipe near the boiler, and in the radiators at all parts of the system, by drawing off through the air-cocks some of the water on to the bulb of a thermometer in an instrument I have specially designed for the purpose.

The uniformity of the rate of rise gives an accurate criterion of the correctness of the circulation, while the absolute rate of rise gives, in conjuction with the known water equivalent of the whole system, the absolute power of the boiler, and the comparison of the latter with the total thermal units in the fuel actually consumed, gives the efficiency of the boiler.

(The results were plotted on curves and submitted to the meeting.)

The thermal value of the fuel consumed should be tested by the calorimeter if great accuracy is desired, or accurate figures relating to boiler efficiency.

Here it may not be out of place to point out how incorrectly, to use the mildest expression, many of the catalogues of the makers of heating appliances describe the powers of their apparatus. We see, for instance, boilers described as having a heating power of "so many feet of 4-inch pipe or square feet of radiating surface," showing that the compilers of the catalogue are unaware that a foot of 4-inch pipe will give off, perhaps, double as much heat as a square foot of some forms of radiator surface at the same temperature. We also read of calorifiers which the catalogues state will heat so many "feet of radiator surface in two hours," whereas the rate of rise of temperature depends not in the least on the radiating surface, but on the water equivalent of the whole apparatus, including the mains and the water in them.

The only correct description of the power of any generator, which nobody but the Germans seem to have yet adopted, is the number of thermal units which the generator will communicate to the system per hour at any definite temperature. Any other description is of necessity not only scientifically innacurate, but frequently very misleading. Makers for the most part are quite unwilling to specify even the number of square feet of surface contained in their apparatus, or their sizes, or their weights, or any other vital particulars, apparently fearing that in doing so they would be giving away some priceless trade secret. Personally, I am always suspicious of apparatus of which the makers will not furnish such particulars as will enable one to calculate as to its actual power. If the apparatus is actually up to its catalogued power, there is no reason why the makers should fear to give its dimensions, and if it is not, it is not always desirable to use it.

I have previously remarked on the necessity of avoiding side issues, and particularly scientific side issues, in making these tests. In illustration I will quote an incident which occurred during one of my tests. Some evil spirit prompted me to attempt a direct measurement of the velocity of circulation in a main of hot water apparatus. The method suggested was analogous to the powder method of ascertaining the velocity in a smoke flue, and consisted in fixing two pet cocks at a measured distance apart in the flow-pipe. The cock furthest away from the calorifier was arranged to dip into a glass vessel containing a solution of silver nitrate, and I intended to force into the other one, near the calorifier, a bicycle pump full of salt water, and to observe with a stop-watch the time when the drippings from the other one produced a white precipitate in the silver solution, showing that the solution of salt had reached that point. Both the cocks were in an underground creeping way, about 3 feet high and quite in the dark, so I illuminated the proceedings by a candle, with a ¾-inch nut as a candlestick. At the critical moment I opened the near pet cock and forced down the plunger of the bicycle pump, when suddenly the rubber tube burst, and the stream of water issuing from it put out the candle and nearly drowned the observer! In the darkness I could not find the spanner for closing the cock, and had to group for it in a puddle of almost boiling water. I tried no more scientific observations after that!

A large number of the most important tests one has to make consist in the measurement of a continuous stream of condensed water as it comes from the apparatus in actual use. The best method of doing this depends on the apparatus available and the degree of accuracy required. The latter question is an important one and the exercise of judgment is called for. For instance, in testing the total amount of steam supplied to the kitchen of an institution for cooking purposes it would be absurd to collect the water condensed in a short interval of time, such as an hour, and accept that figure as a result of any value, for the whole

result would be upset by a kitchen maid turning on more steam in a soup boiler than was required. On the other hand, in testing the amount of steam required per hour in a battery of steam pipes through which a fan is blowing a certain quantity of air per hour, half an hour's observation is quite sufficient. In the former case the only test that can have any practical value is to collect the whole of the water condensed during the day, and it is also very useful to run a further test for another whole day, satisfying yourself by personal observation that no more steam is being used than necessary for the purpose in view.

Such tests are extremely unpleasant to make, because in many or most cases it is necessary to collect the water at boiling temperature in a subway in which the temperature may be anything from 100 degrees to 130 degrees, and the steam from the water makes such tests about as trying an experience as can well be imagined. Whenever it is possible I arrange to carry a temporary line of condensed water pipes to the coolest and most easily accessible part of the subway that I can find, and take the measurements there.

The method adopted in all such cases as this is to fit up two 30-gallon tanks, each having a waste-pipe leading from a point about 2 inches from the bottom of the tank, and each being provided with a valve, the outlets from which are connected into a common waste-pipe. The tanks are special ones which I keep expressly for the purpose, and are carefully calibrated by leveling them on the platform of an accurate weighing machine. Inside each in turn a gauging apparatus is placed, consisting of a deep zinc cylinder with a heavy cast-iron bottom, and perforated with several holes near the bottom. Inside this is a copper float, working vertically in the cylinder, and carrying a guide rod and scale which works past a vernier fixed to a crossbar fastened across the top of the cylinder. This cylinder when placed in a tank of water enables the depth to be accurately gauged by reading the vernier. The tanks are weighed empty and also weighed when containing water heated by naked steam to 180 degrees (which in practice is approximately the general temperature in a tank when collecting condensed steam), and corresponding readings of the vernier noted. A curve is then drawn showing the number of pounds of water corresponding to any height or difference of height in the tank.

These tanks so calibrated are placed at an early hour in the morning, say, 4 o'clock, under the disconnected outlet of condensed water from the apparatus, and carefully leveled, and the depth of water in them noted every ten minutes throughout the day. When one tank is full, the stream of condensed water is diverted to the other tank by means of a wrought-iron bend. The necessary readings are taken from the first tank, and the contents then run away to waste, and a similar system adopted with the other tank. This method of two tanks is extremely useful, as it enables every drop of water to be collected and accurately measured with a minimum of inconvenience and a maximum of accuracy, and also furnishes a reliable check of the total quantity of water. After the test is finished the total water is calculated and plotted on a curve for future use.

The same two tanks are also used for such things as the determination of the total amount of hot water used in a laundry. In this case the tanks are fixed over the main feed-tank, and the water supply to the latter is diverted into the calibrated tanks in turn, and then run from the calibrated tanks into the main feed-tank up to a certain level, account being kept of all the water fed into the latter.

Another method which is often very convenient, as it can generally be carried out without breaking any joints whatever, and is sufficiently accurate for many purposes, is to utilize an existing fixed tank for the measuring vessel and placing therein the portable cylindrical gauge previously described. Thus, in measuring the total condensation in a large system of steam mains (this is a test which has to be carried out during the night, when the whole of the apparatus can be shut off except the steam mains) I arrange to keep up the pressure in one boiler all night, and collect all the condensed water in the feed-tank, the height of which is measured at suitable intervals of time by means of my gauge. The temperature of the water and the inside dimensions of the tank are noted, which furnish the necessary data for determining the amount of condensation. The temperature in the subways and the temperature at the surface of the coating are also noted, which furnish a check on the quality of the composition used. A period of three to four hours is sufficient for this test, as the rate of flow is practically constant.

By the same means the total quantity of steam used in an institution throughout the day, and by similar means the total consumption of hot water used in the service system, are measured. For the latter I usually get access to the main feed tank, the dimensions of which are carefully taken. Then at 4 A. M., which is the hour at which these all-day tests are commenced, the tank is filled up as high as possible and the ball-valve tied up. Readings are then taken of the tank at suitable intervals until the tank is nearly empty. It is then filled as rapidly as possible by opening the valve to full bore.

During the time it is filling, it is, of course, impossible to take readings of water used, and the author adopted a method for filling up the blanks in the curve of total consumption.

(These plotted results were submitted to the meeting, and as an illustration of their value the author explained a problem which has firm met with when required to provide a hot water tank large enough to conserve the heat of the exhaust steam from a set of electric light engines, the problem being to determine the size of the tank necessary. The method was explained.)

BOILER TESTS

These are made in the ordinary way by measuring the fuel consumption, the feed and various other matters. In measuring the total feed I use the main feed tank as measuring vessel, which is worked in such a way that no boiler connections need be broken. The tank is first filled up to the top, all condensed water pipes running into it are diverted to the drain, and the feed pumps are set going at an uniform rate, the level in the boiler being kept at a fairly high constant level. The amount pumped out of the feed-tank is then measured at suitable intervals. When the feed-tank gets low the feed-pumps are stopped, the tank gauged by my cylindrical gauge, and filled up again, measured, and the pumps again started. These observations, combined with the size of the tank and the temperature, are sufficient to calculate accurately the amount pumped into the boilers. The fuel is weighed into one-half hundred-weight heaps, and the time of feeding the furnace and the amounts thrown in noted.

These boiler tests are usually continued throughout the whole period of the tests, except when the feed-tank is required for other tests. After all the tests are completed I draw up a balance sheet showing how the total steam supplied by the boilers is distributed among the various services. It is usually possible to account for the whole of the steam supplied by the boiler to within 5 per cent., and this variation is not to be wondered at, considering the diverse character of the services supplied and the variation from day to day.

British National Association of Heating and Domestic Engineers

This is a new organization whose object, as officially stated, includes the promotion and protection of the interests of employers in the heating, ventilating and domestic engineering trades generally, as regards industrial and labor questions throughout Great Britain and Ireland.

The membership embraces leading firms in most districts of the British Isles, and it is probable that the new organization may be considered as successfully launched.

Some of the subjects suggested for consideration and for united action are the following:

Dealing with the purchase of material.

The organization, status and efficiency of the workmen in the employ of mem bers.

The use of inquiry forms by members when taking on workmen.

The circulation amongst members of the names of approved and recommended foremen and workmen seeking employment.

Taking up and dealing with questions involving general principles, particularly those which are raised by the trades unions.

The collection and tabulation of information regarding the customs and practices of the trade, rates of wages, hours of employment, etc., for the use of members.

D. M. NESBIT
PRESIDENT BRITISH HEATING ENGINEERS' ASSOCIATION

The circulation of a journal or report for the information of members.

Enlisting the co-operation of architects and consulting engineers and water engineers.

Watching legislation and Parliamentary or other movements on labor questions.

Representing the interests and views of members to public bodies and on public occasions, and acting jointly with other Employers' Associations in furtherance of mutual interests.

The officers of the Association are: President, D. M. Nesbit, of London and Leicester; Vice-Presidents, J. H. Clements, of London; C. Ingham Haden, of Trowbridge; and J. Nelson Russell, of London. Members of Council, Richard Crittall, of London; J. Alfred Dargue, of Liverpool; Henry H. Jennins, of Leeds; G. E. Killick, of Liverpool; H. S. Moor-

wood, of Sheffield; Samuel Saunders, of Manchester; A. B. Simpson, of London; W. T. Stainton, of London; Thomas Taylor, of Birmingham, and J. G. Walker, of Newcastle-on-Tyne. Secretary, Hugh Boyd Watt.

The President, Mr. Nesbit, has for years been familiar, and in more or less close touch with, the operations of the Master Steam and Hot Water Fitters of the United States. He has a close personal friendship with the prominent officers of our American organization and is acquainted with their work and with the objects which they seek to achieve. No better man could have been selected to impress upon our British cousins the principles governing such a body and the objects to be achieved.

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

The Board of Directors of the National Association of Master Steam and Hot Water Fitters held their semi-annual meeting at the National headquarters, 260 W. Broadway, New York, November 15. Those in attendance were: President H. L. Hall, Vice-President P. Gormley, Treasurer A. N. Chambers, Secretary H. B. Gombers and Messrs. A. E. Kenirck, Harvey Middleton and John T. Sadler.

Reports were presented, showing the first results of the newly-appointed special representative, W. A. Davis, in the shape of increased membership in Connecticut and Western Massachusetts.

An important part of the business of the meeting was the consideration of applications of manufacturers to be placed on the "List in Accord." These were turned over to the Committee on Trade Relations with an expression that it was the disposition of the Board to treat such applications in the most liberal spirit. The matter will be brought up again at the January meeting and it is expected that the more liberal policy contemplated will result in the admission of an increased number to the "List in Accord."

The *Official Bulletin* for November announces the appointment of William A. Davis as special representative for the purpose of increasing the Association membership. The *Bulletin* says:

"A step that is expected to have a most important effect on the future of this Association was taken when the Board of Directors at a recent meeting appointed Mr. William A. Davis as Special Representative for the purpose of increasing the Association's membership.

Mr. Davis' itinerary, it is expected, will shortly take him to various sections of the country, and our members, as well as the trade at large, are asked to be on the lookout for his arrival and to render him what co-operation lies in their power.

Mr. Davis has had experience in organization work and this will doubtless serve him to advantage in his present capacity. For two years past he has been connected with the National Manufacturers' Association, one of the best-known and most influential bodies of employers in the country, and during that time he was successful, with others, in increasing its membership from 1,200 to 1,300 members.

He is at present calling on the trade in Connecticut and Massachusetts where he has been successful in interesting the steam fitting trade in this Association and largely augmenting our membership in those states. During the coming month

W. A. DAVIS
SPECIAL REPRESENTATIVE, M. S. AND H. W. FITTERS

he will possibly visit the States of Pennsylvania and Ohio.

Mr. Davis says the thoughts which have the most influence in securing new members are the co-operative features of the Association, together with the fact that the average master steam fitter is just about the best balanced man to be met with and quick to see the advantages of the trade's pulling together.

'Perhaps,' he said, 'it is the steam fitting experience that rounds and develops the man to quick thought and prompt action. As one master fitter in Connecticut put it: "A man successful as a master steam fitter can run any business. Managing a department store would scarcely keep him awake, and being elected Mayor of a city would find him prepared to take the contract."'"

TRADE AND MISCELLANEOUS NOTES

ALBERT KROESCHELL died at his home in Chicago, November 24. Mr. Kroeschell was 54 years of age, was president of the Kroeschell Bros. Ice Machine Company, and vice-president of the Kroeschell Bros. Co., heating contractors.

BERNARD B. MAGINN, president of Maginn & Bradley Company, Chicago, died November 28, at the age of 31.

OLIVER P. DICKINSON, credit manager for the Crane Co., Chicago, died October 6. Mr. Dickinson was formerly a banker at Kansas City, and has held his position with the Crane Co. for many years.

W. E. MARION succeeds Britt Marion in the firm of White & Marion Rensselaer, Ind.

W. H. BURNETT CO., Youngstown, Ohio, is a new heating and plumbing corporation; capital, $15,000.

E. HUFF, JR., has started in the heating business at 8644 Eighteenth avenue, Bath Beach, N. Y. Mr. Huff has for years been connected with the Smith & Anthony Co., Boston.

J. A. SKELLY, Greensburg, Pa., made an assignment but has obtained enough money to buy back his plumbing and heating shop and will continue in the business.

PETALUMA RADIATOR CO., Oakland, Cal., will remove their works to Port Richmond in connection with the Richmond Foundry Co., at that place.

SPRINGFIELD HEATING & VENTILATING CO., Springfield, O., is a new concern, the officers of which are: President, J. A. Humphreys; Secretary and Treasurer, E. G. Herbert, and Superintendent, R. S. Thompson.

POWELL & RENNINGER, 602 S. Main street, Findlay, Ohio, succeeds A. E. Powell.

FREEPORT PLUMBING & HEATING CO., Freeport, Ill., has been incorporated by George J. Dehn, William Buez and William H. Fox, with a capital of $5,000.

F. R. LAVERTY, for years connected with L. D. Hosford, 68 Beekman street, New York, has started in the heating and plumbing business at 39 Beekman street.

E. A. BURBANK & CO., a corporation, succeeds to the heating and plumbing business of E. A. Burbank, Berlin, N. H.

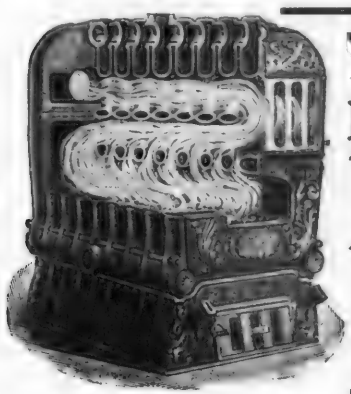
SANITARY HEATER CO. is a new corporation at Portland, Me., with a capital stock of $800,000.

MUIRHEAD & MURHARD CO., Portland, Ore., a corporation, succeeds to the heating and plumbing business of Muirhead & Murhard.

KONRAD MEIER is a new heating and ventilating engineer, having opened an office a few weeks ago at 27 East Twenty-second street, New York, where he will prepare plans, specifications, reports, etc.

Mr. Meier had had years of experience and is well qualified to carry out the work which he has undertaken.

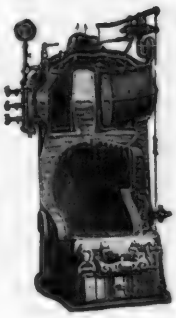
ELK HEATER MFG. CO., Columbus, Ohio, has been incorporated, with capital stock of $10,000, by J. J. Lentz, C. M. Addison, Lincoln Fritter, W. B. Cassidy and T. B. Galloway.



WALKER BOILERS

GOOD BOILERS THAT'S ENOUGH

WALKER & PRATT MANUFACTURING COMPANY BOSTON, MASS.



NIAGARA BLOWER CO., Buffalo, N. Y., has been incorporated with $25,000 capital, by Maulsby Kimball, Henry Ginnane and Hart Lincoln.

ARGAND BOILERS, vertical sectional, steam and hot water are manufactured by Fred D. Johnson & Co., 30 East Twentieth street, New York, and described in a handsome 32-page catalogue.

These boilers range in capacity from 700 to 4,550 feet for steam and from 1,170 to 7,475 feet for water. There is also a line of round Argand boilers, 450 to 750 feet of steam capacity and 940 to 1,560 of water.

AIR COMPRESSORS and vacuum pumps are described in a 48-page pamphlet, 6x9 inches, just issued by the Clayton Air Compressor Works, 114 Liberty street, New York city. More than twenty-one types of machines are shown in the illustrations, including single and duplex machines, steam-driven, power-driven and electrically-driven by gear, chain and belt. The last page also shows air compressors driven by direct-connected oil engines, forming small convenient units which may be installed almost anywhere and which are said to be used extensively in quarries, stone shops, small machine shops and all small plants where air is used for general purposes, such as cleaning, etc. Other pages describe the air lift, the uses of compressed air in car barns, vacuum machines for experimental work, etc. The range of sizes includes machines displacing from two cubic feet of free air per minute to those having a capacity of 1,400 cubic feet.

HART & CROUSE CO., New York and Utica, N. Y., send us their list of capacities and prices of Royal heaters.

Of the Royal steam vertical sectional heater, 38 sizes are shown, ranging in capacity from 210 to 7,500 feet.

Of the Royal vertical sectional hot water heaters, 38 sizes are shown, the capacities ranging from 360 to 12,900 feet of radiation.

Both these relate to the new "Improved Royal," a special feature of which is the absence of any flat surface between the sections to accumulate rust and push the sections apart.

The round Royal heaters are, as described, "circular sectional," round boilers made in halves, properly fitted together. There are only two sizes of these boilers, having 20 and 24-inch fire-pots respectively.

The Albany Return Steam Traps

have been the **STANDARD** for over **THIRTY-TWO YEARS.** For returning water under pressure to the boiler, they will perform this duty fully as well, and in many cases better than the so-called steam loop.

Send for circulars A, B, C and D.

MANUFACTURED BY

ALBANY STEAM TRAP CO., ALBANY, N.Y.

FREDERICK TOWNSEND, PRESIDENT — JAMES H. BLESSING, GEN. MGR.

KENT'S ENGINEER'S POCKET BOOK

A REFERENCE BOOK OF RULES, TABLES, DATA AND FORMULAS FOR THE USE OF ENGINEERS, MECHANICS AND STUDENTS

The Standard Book of Reference. 1100 Pages

Price $5.00

HEATING AND VENTILATING MAGAZINE

1123 Broadway, New York

UNIFORM TEMPERATURE in railway cars is, as we all know, most desirable and rather unusual. The temperature of the Empire State Express, New York Central's celebrated train, is controlled by the Powers Regulator. The company issue a little card exploiting this fact.

A GREAT, BIG HANGER, about 24 by 36 inches, has been prepared by the Kellogg-Mackay-Cameron Co., to adorn the walls of steamfitting shops, and it is well calculated to adorn them because the design is striking and the execution excellent. A pleasant-looking, fur-clad young woman, apparently just in from a walk or a sleigh-ride, has hastened to the radiator over which she is warming her white-gloved hands. At the same time her fox terrier is warming his nose at the same radiator.

At the top is the motto: "Summer All Winter—Estimates Made Here." Those of the trade who would like this handsome hanger on their walls or in their windows can procure one by addressing Kellogg-Mackay-Cameron Co., Lake and Franklin streets, Chicago.

MODEL HEATING CO., Philadelphia, has produced one of the prettiest and most unique booklets we have ever seen. Its title is "Do Not Shiver in a Cold House," and the amount of information and suggestion furnished for the prospective buyer, the clever style it is written and the attractive way in which it is put up are sure to produce effective results for all steamfitters who use the Model goods.

CRANE CO., Chicago, issue their special catalogue No. 100, containing about 100 pages devoted to the Crane patent valves and boiler trimmings.

SMOOTH-ON MFG. CO., Jersey City, N. J., have prepared a new illustrated catalogue of their various products.

NATIONAL REGULATOR CO., Chicago, send us a copy of their new catalogue of the National Automatic Temperature Regulator which contains, first, a brief history of the progress of the company, then a little essay on the necessity for heat regulation and a general discussion on thermostats, their control of dampers and of radiators; a chapter on the regulation of residences and one on thermostatic control of hot water supply, all illustrated with clear diagrams. The last pages of the book are devoted to halftone engravings of some of the buildings in which their apparatus has been installed.

THE BOILEROLOGIST No. 3 comes to hand, and gives more information, or the same information in different form,

"Sunrays" are pleasant in Winter

Why not use Sunrays in your business?

We will make it pleasant and profitable for you to use them.

The J. L. Mott Iron Works

84-90 Beekman St., New York

about the Walker & Crawford boilers, whose war cry is "honest ratings." This little publication is issued by the Walker & Pratt Co., 31 Union street, Boston, who will be glad to place on their list any one not now receiving the Boilerologist.

IMMEDIATE SHIPMENTS of Capitol boilers and radiators is advertised by the United States Heater Co., Detroit. They state that they have an ample stock in their warehouses at Detroit, New York, Philadelphia and Springfield, Mass. They solicit rush orders.

ABENDROTH & ROOT MFG. CO., Newburgh, N. Y., issue a very complete little booklet devoted to their specialties, giving particular prominence to the Root spiral riveted pipe. One statement made, which strikes us as remarkable, is that when this pipe is tested to the bursting point rupture of the metal occurs always near the middle of the strip, showing that the seam is the strongest point and not the weakest, as in straight seam pipe.

The company also make castings, engine repairs, exhaust heads, tanks, valves and a variety of other articles.

Copies of the catalogues will be sent on application.

STEAM REGULATING DEVICES and steam pumps are manufactured by the Mason Regulator Co., 158 Summer street, Boston, who issue a small catalogue describing their product. They show the Mason hydraulic damper regulator, Mason Reducing valve, pump pressure regulator, automatic belt shifter, balanced valve, lever valve, pump governor, etc.

Copies of the book will be sent on application to the manufacturers.

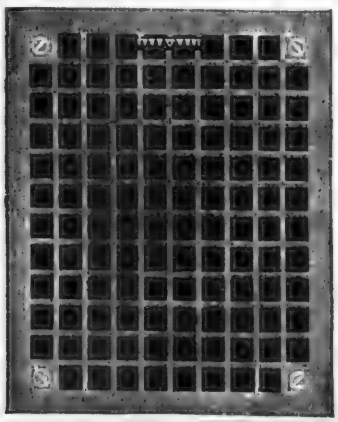
"MECHANICAL RUBBER GOODS" is an expression covering wide latitude; included in it are water hose, steam hose, diaphragms, gaskets, all kinds of packing, etc.

Everything made of rubber may be had from B. F. Goodrich Co., Akron, Ohio, who have prepared a most attractive catalogue describing their product.

E. D. HORNBROOK, President of the National Association of Master Plumbers, sends us a November directory of recognized Master Plumbers in the United States where there are members of the National Association.

"ON THE WARPATH, but not for scalps," is the legend on a large mailing card of the Griffing Iron Co. The accompanying illustration, however, suggests a rather strenuous method of getting orders for Bundy boilers and radiators.

AMERICAN BLOWER CO., Detroit, Mich., send out their catalogue No. 171,



Kernan Registers

ALL SIZES AND FINISHES
WE CAN SAVE YOU MONEY

Syracuse Stove Works,
SYRACUSE, N. Y.

Telephone, 383 John.

NEW YORK BRANCH,
231 Water St.

ELMO AIR VALVES

AUTOMATIC FLOAT

LOCK SHIELD AUTOMATIC FLOAT

First class, high grade goods. Close by flotation and expansion. Many special features of excellence which will be readily appreciated : : :

PHELPS BROTHERS
210 Water Street New York

describing the "A B C" vertical, high-speed, self-lubricating, inclosed type steam engine, designed for the operation of blower fans, and ranging in capacity from 3 to 30 horse power.

"WINTER IS COMING," is the announcement of the A. A. Griffing Iron Co., who call attention to their Bundy boilers and radiators.

ABENDROTH BROS., New York and Port Chester, N. Y., state that they have an interesting proposition for heating men. It is probably something in connection with the celebrated "Gem" boilers.

ORR, PAINTER & CO., Reading Stove Works, Reading, Pa., have a pocket catalogue of Sunshine steam and hot water heaters, giving an illustration and full description of these well-known boilers. The catalogue also contains various other useful information.

J. M. LITCHFIELD, 228 Water street, New York, issues a postal card emphasizing the merits of his line of small hot water heaters for greenhouses, hotels, restaurants, etc.

SMITH & ANTHONY CO., Boston, Mass., well-known manufacturers of "Hub" heaters, devote their latest advertising circular to their Hub ranges. It consists of a large mailing card, the keynote of which is the golf and Thanksgiving season. Their illustration shows a club house flying the banner of the "Hub golf club," and on the wall is a sign, "Find the Hub Turkey."

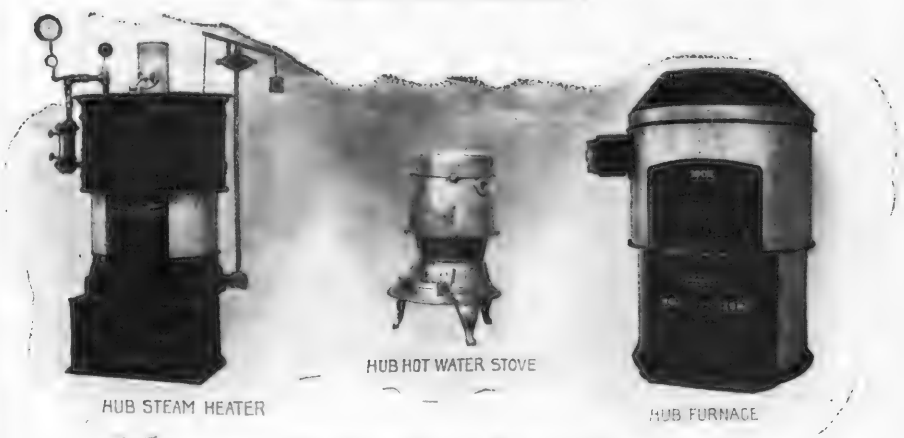
WALWORTH MFG. CO., Boston, have connected with them a number of men whose services extend back a great many years. A conspicuous example is their buyer, Edward H. Rice, who completed his fiftieth year in the company's service October 19. The event was signalized by the presentation of a loving cup from the members of the firm and his associates in the business.

AEOLIPYLE CO., 237 Water street, New York, have not only had the biggest year of their existence, which was natural, but one so much bigger than they had expected that they are exceedingly happy, particularly as the cold weather held off long enough to enable them to get their most pressing orders satisfactorily filled.

SYRACUSE STOVE WORKS, Syracuse, N. Y., have greatly increased their rapidly growing business this fall by the popularity of the Kernan shell grate bar and by their aggressive work on the Kernan registers, which are so well designed and well made as to meet with immediate favor.

Hub Heating Apparatus

SUPERIOR IN DESIGN, CONSTRUCTION AND EFFICIENCY



HUB STEAM HEATER

HUB HOT WATER STOVE

HUB FURNACE

Manufactured and Warranted by

SMITH & ANTHONY COMPANY, BOSTON

NORWALL MFG. CO., Chicago, are among the very busiest people in the heating business. For a long time it has been difficult to go anywhere without encountering either Hoffman or Allen. Now they have actually invaded New York and set up for themselves right on our own premises. They have office accommodations at 1123 Broadway, to be presided over by the youthful veteran, Geo. D. Hoffman.

RHODE ISLAND ENGINEERING CO., Providence, R. I., is a comparatively young concern, but has made a marvelous growth. Some four or five years ago they put up one of the most completely equipped buildings for its purpose in the country. They have now bought additional ground and when their new buildings are completed, they will occupy 60x290 feet.

This business is managed by President John W. Mills, who is justly proud of his achievement. Mr. Mills was previously famous as Vice-President of the United States Heating Co., and afterwards New York manager of Crane Co.

KELLOGG - MACKAY - CAMERON CO., Chicago had an unpleasant experience at their Minneapolis branch. On November 24 a fire broke out and destroyed the upper floor of the building in the lower part of which are their branch offices and warehouse. The fire was a hot one at first and a very wet one at the last, and the K. M. C. Co.'s premises were completely flooded. By energetic work they put things to rights so quickly as not to permit any delay or inconvenience to their customers.

UNITED STATES RADIATOR CO., Dunkirk, N. Y., have let contracts for a large addition to their already large plant. They have been adding machinery and equipments for some months, but the new addition will be mostly to their foundry and will give them a largely increased output. The work is being pushed as rapidly as the weather will permit and is expected to be available so early in the spring as to give them the full benefit of it for the season of 1905, when we may expect to see more Tritons sold than ever before.

HOWARD & MORSE, New York, makers of Blackman Exhaust Fans and other products, find themselves in an uncomfortable situation in regard to their factory. Their business has been growing steadily for years and the past season has overcrowded their manufacturing facilities so that they foresee the necessity for a change. Unfortunately they are

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SAVES Time, Labor, Coal.

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surrounded by property so improved and occupied as to make its purchase and the consequent destruction of buildings unduly expensive, and they cannot well divide the business because their existing plant would be too large for the fan business alone and too large for the other business if the fan works were located elsewhere. The only thing that suggests itself is that they should not sell so many goods.

FRED D. JOHNSON & CO., 32 West Twentieth street, New York, have had an extraordinary business for the first year of their Argand steam and hot water boilers. The figures which they give as the result of their selling efforts show excellent ability and an excellent appreciation of their goods by the trade.

GIBLIN & CO., Utica, N. Y., have appointed Robert Campbell, 106 Beekman street, New York, as New York representative of their line of boilers and furnaces.

KELLOGG-McCRUM-HOWELL CO., New York, opened not long ago a Cleveland office under the management of H. S. Gardner. They have since found it necessary to call Mr. Gardner to New York to supply a demand at the home office for someone to take charge of the order and billing department and they called upon Mr. Gardner to take the place. While the company lose the services of an expert salesman, they have gained an eminently qualified office man.

ANDREW C. MERCER, for so many years manager of the New York office of the H. B. Smith Co., Westfield, Mass., has suffered from ill health all summer. His friends are glad to see him at the office again, although he does not spend much time there on the ground, as he states, that he is "getting old and lazy," and he has found that matters have been satisfactorily looked after under the management of J. C. Faulkner.

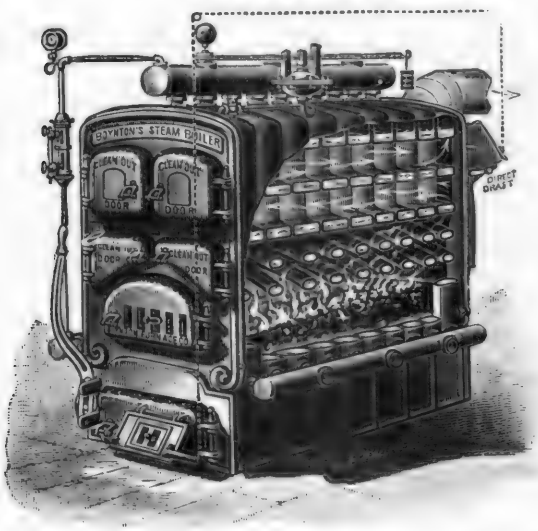
GEO. A. WELD CO., Boston, Mass., have appointed the John Simmons Co., 110 Centre street, New York, sales agents for New York territory for their thermostatic controlling devices.

PEERLESS VALVE & HEATER CO., Detroit, Mich, have completed a new foundry and machine shop, 98x100 feet, fitted up in thoroughly modern fashion. The president and manager of this company is Clarence H. Booth and its product is steam and hot water boilers, valves, etc.

AMERICAN RADIATOR CO., Chicago, at a recent directors' meeting declared a one per cent. dividend on their common stock, payable December 1.

The company has been in operation over five years, and in that time has paid nothing on the common, accumulating instead a surplus which now amounts to $2,056,885, or 42 per cent. on the common stock

The Boynton Steam Boilers and Hot Water Heaters



Manufactured in 84 Sizes suitable for any requirements.

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WRITE FOR CATALOGUE

The BOYNTON FURNACE COMPANY

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issue of $4,893,000. On the preferred issue of $3,000,000 regular quarterly dividends of 1¾ per cent. have been paid. The balance sheet submitted at the annual meeting showed quick assets of $2,928,585 and accounts payable amounting to $316,137, leaving net quick assets of $2,612,448.

Following shows the amount of surplus applicable to the common stock since the organization of the company:

1900.	1902.	1903.	1904.	Total.
$499,692	$417,614	$491.094	$335 517	$2,056,885
%10,21	8.5	10.0	6.75	42 0

After the meeting of the board of directors President Woolley made the following statement in connection with the action on the common stock:

"The company having devoted six years to the creation of a substantial fund for working capital, and as the business this year, both as regards volume and net profits, is progressing satisfactorily, it was decided that it would be prudent and conservative to begin the payment of dividends on the common shares.

AMONG THE AWARDS thus far announced at the St. Louis Exposition are the following: American Radiator Co., Chicago, one grand prize and one gold medal for heating apparatus; Ashcroft Mfg. Co., New York, grand prize, steam brass goods; Schaeffer & Budenberg, Brooklyn, N. Y., grand prize, engine trimmings, etc.; Crosby Steam Gauge & Valve Co., Boston, grand prize, gauges and valves; Trimont Mfg. Co., Roxbury, Mass., gold prize, pipe wrenches.

C. B. J. SNYDER, architect and superintendent of school buildings, of the New York Board of Education, has been enjoying a well-earned holiday in Europe. Our last letter from him was dated at Milan, Italy.

CHARLES S. STEPHENS, well known for years to all buyers of pipe, has been appointed eastern representative of the Wheeling Steel & Iron Co., with headquarters at 21 Beekman street, New York.

W. M. MACKAY, secretary of the American Society of Heating & Ventilating Engineers, entertained D. M. Nesbit, of London, at his home in Newark, Thanksgiving Eve. Among the party present were Messrs. F. K. Chew, of the *Metal Worker*, and H. A. Smith of the HEATING AND VENTILATING MAGAZINE.

THE WEBSTER SYSTEM of steam circulation will be installed in the new department stores of John Wanamaker in Philadelphia and New York. The Webster system was used in the old Philadelphia store for six years, and gave such satisfaction that it was adopted for the new stores, which are the largest buildings of their kind in the world.

"Novus" Wall Radiator

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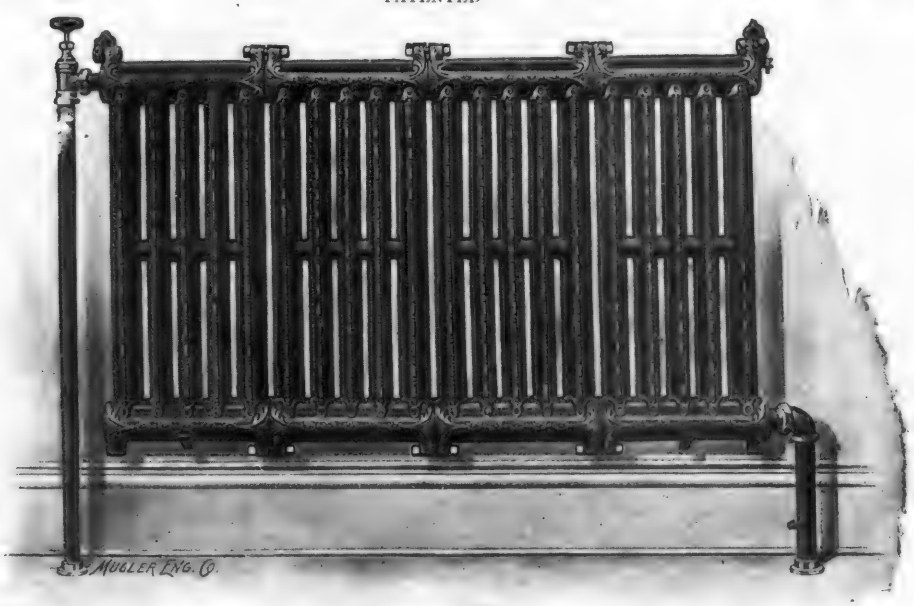


Slip Nipple Connections Consequent freedom from leaks when many sections are combined in one radiator. Easily assembled without special tools. **Artistic in Appearance**

National Radiator Company, Johnstown, Penn.

GEORGE PECK, of Peck & Co., Amsterdam, Holland, is spending a few weeks in this country and has seen all of it from New York to San Francisco and St. Louis.

HAWES & GRAY, have removed their heating and plumbing business at 37 Dwight street, Springfield, Mass.

E. RUTZLER & CO., 127 White street, New York, succeeds to the business of E. Rutzler. The directors are Enoch Rutzler, John E. Rutzler and Erastus Everett.

STEAM SUPERHEATER CO., is a new corporation at Dover, Del. They are incorporated to manufacture and sell all kinds of steam generators and heating apparatus; capital stock, $250,000.

KRUSE CO., Milwaukee, Wis., is a consolidation of the Mooers Co. and the Chas. B. Kruse Heating Co. President and Treasurer, W. K. Downey; Vice-President and Superintendent, Chas. B. Kruse.

SPRINGFIELD HEATING & VENTILATING CO., Springfield, Ohio., is a new incorporation to handle furnace devices. R. S. Thompson is superintendent, a man of long experience in his line.

HARRY KIEFER CO., Brooklyn, N. Y., manufacturers of heating apparatus, has been incorporated with a capital of $10,000.

CAPT. A. B. RECK, the well known heating and ventilating engineer, of Copenhagen, Denmark, is in this country again. Capt. Reck, it will be remembered, read an interesting paper describing his special system before the January meeting of the American Society of Heating and Ventilating Engineers, of which he is a member.

H. C. ADAMS, well known in the heating trade for many years, is looking after the boiler and radiator interests of the Kellogg-McCrum-Howell Co., New York, as special representative, devoting himself particularly to architects.

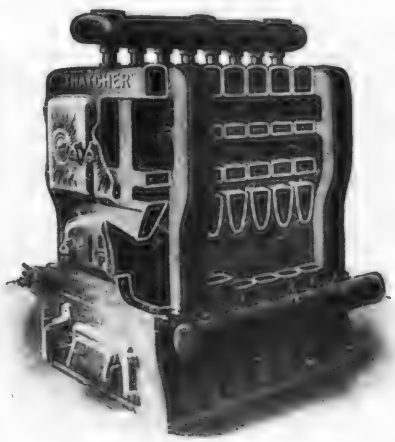
H. L. HALL, president of the National Association of Master Steam and Hot Water Fitters, gave a little lunch at the Aldine Club the other day to D. M. Nesbit, president of the British Association of Master Fitters. There were also present Messrs. W. P. Powers, of the Powers Regulator Co., Chicago, and H. A. Smith, of the HEATING AND VENTILATING MAGAZINE.

WILLIAMS HEATING CO., New York, is a new corporation with a capital of $10,000.

Heating Contracts

N. PERRY & CO., Attleboro, Mass., heating New Bronson building.

BARNEY GIBBONS, Milford, Mass., heating Murphy Block.



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performs its duties perfectly; which duties are to warm the coldest house in the coldest weather at an extremely low fuel cost.

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Works: NEWARK, N. J.

WILLIAMS HEATING CO., 81 Fulton street, New York, heating residence for Chas. E. Bigelow, Seventy-second street and Riverside Drive.

McGRAW & HENRY, North Adams, Mass., heating Notre Dame church, North Adams.

E. BROWN CO., Palmer, Mass., heating Congregational parsonage.

WILLIAM OAKES, 1120 Pine street, Philadelphia, heating and ventilating school building, Holly Beach, N. J.

R. J. FOLEY, Newburyport, Mass., heating and ventilating new French Catholic Church, on Beck street.

FITZGERALD BROS., 19 Pritchard street, Fitchburg, Mass., heating residence of John Fallon, Fulton street; heating and plumbing residence John Farrell.

GUY A. JACKSON, 1039 N. Fourth street, Philadelphia, Pa., heating Comet Club.

ALFRED SAYERS, 820 S. Eighth street, Philadelphia, Pa., heating new Park Hall, Camden, N. J.

C. H. WILSON, Gettysburg, Pa., heating Old Women's Home.

WALKER & PRATT MFG. CO., 31 Union street, Boston, Mass., heating two $60,000 residences on Beacon street for R. W. Sears and R. P. Williams.

INGALLS & KENDRICKEN, 90 Sudbury street, Boston, heating $1,00,000 department store.

WILLIAMS HEATING CO., 81 Fulton street, New York, heating large orphan asylum, Union Hill, N. J.

GILLIS & GEOGHEGAN, 537 W. Broadway, New York, heating Bell building, Fifth avenue and Thirty-second street.

HOHN & ODELL, Rye, N. Y., heating residence of Samuel Wells, Loundesbury Park.

L. H. KURTZ CO., Des Moines, Iowa, heating new school at Ames, Iowa.

ARMS & COLE, Traverse City, Mich., heating and plumbing new Federal Building, State and Cass streets.

ALLEN, MYERS & CO., Rock Island, Ill., heating residence of John J. Pryce and William Paul, Coal Valley, Ill.

HUEY BROS., 35 Hanford street, Boston, Mass., heating the Lyman street school house, East Boston.

PIERCE & COX, 143 Kingston street, Boston, heating $12,000 residence of Mrs. Tyler, Cambridge.

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NEW YORK

B. F. STURTEVANT CO., Boston, heating and ventilating new high schools, at Appleton, Wis.

A. H. BROWN, 418 Pearl street, Sioux City, Iowa, heating and plumbing J. W. Brown's residence.

ROSS BROS., Edmonton, N. W. T., heating municipal buildings.

JOSEPH HARRISON, 608 Yonge street, Toronto, heating new building of Copp, Clark & Co.

FOSTER HEATING CO., 15 Palmer street, Roxbury, Mass., heating Wolfboro Academy, Wolfboro, N. H., using two 4,400-foot Richmond boilers.

HARRY F. BITZ, 135 Willett avenue, Port Chester, N. Y., heating residence of H. A. Banks.

L. C. WENKENBACH, 26 Adee street, Port Chester, N. Y., installing heating system in county court house.

BITZ BROS., Rye, N. Y., heating a store and apartment house for August Wagner.

A. HATTERSLEY & SONS, 48 E. Main street, Fort Wayne, Ind., heating new addition to college building.

GEO. F. SHEERER, Cedar Falls, Iowa, heating and plumbing city library, Algona, Iowa.

OLL MILLER, Warrensburg, Mo., heating and plumbing residences of Judge Welborn, Lexington, Mo., and of Lee Hartzler, Harrisonville, Mo.

J. J. DANEK, Hutchinson, Minn., heating Polish Catholic Church.

W. P. HORNER, Ogontz, Pa., heating and plumbing St. John's Lutheran church.

FRANCIS BROS. & JELLETT, 245 N. Broad street, Philadelphia, Pa., heating Mt. Sinai Hospital, Fifth and Wilder streets.

DETTNER & HANDWERK, Slatington, Pa., heating Trinity church.

J. M. SMITH & CO., Minneapolis, Minn., heating Boston Candy Store.

H. KELLY & CO., Minneapolis, Minn., heating new court house at Windom, Minn.

CAMPBELL HEATING CO., Des Moines, Iowa, heating Howard Memorial church, Kansas City, Mo.

A. T. STEBBINS & CO., Rochester, Minn., installing steam system for city hall, using exhaust steam from electric light and power station.

ENGLER & DUDGEON, Emmettsburg, Ind., heating new theater and store building.

FARGO PLUMBING & HEATING CO., Fargo, N. Dak., heating and plumbing building for International Harvester Co.

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W. P. HORNER, Ognotz, Pa., heating residence of Mr. Muckle, Swarthmore, Pa.

H. C. LOWDEN & BRO., 9 S. Fortieth street, Philadelphia, Pa., heating, plumbing and gasfitting building at Locust Wood Cemetery, N. J.

MAKIN HEATING CO., 18 S. Seventh street, Philadelphia, heating residence at 1304 N. Broad street.

AUGUST GREIGER, 114 N. Sixth street, Philadelphia, heating new building at Norfolk, Va.

GROELING & WEIGAND, 403 W. Susquehanna avenue, Philadelphia, heating Hood Leather Co.'s factory, Richmond and Tioga streets.

SAMUEL W. BARNES & SONS, 2106 N. Sixth street, Philadelphia, heating Gill & Co.'s factory at Simon and Tioga streets.

FRANCIS BROS. & JELLETT, 245 N. Broad street, Philadelphia, heating factory building at 13 N. Third street.

HOBEN & DOYLE, Pine and Twenty-first streets, Philadelphia, heating factory of Geo. W. Smith & Co., Powelton avenue.

WILLIAM M. ANDERSON, 108 S. Twentieth street, Philadelphia, heating and plumbing dormitory building, State College, Pa.

T. J. CUNNINGHAM, 4324 Frankford avenue, Philadelphia, heating and plumbing residence of Edward Stern, Holmesburg, Pa.

SAMUEL BUCHANAN & CO., Huntington, Ind., heating and plumbing building for Conradt Bros.

A. E. VESPER, Pasadena, Cal., heating city library.

DANIEL HUNSBERGER, Royersford, Pa., heating new Episcopal church.

JOSEPH O. EBEN, Ontario, N. Y., heating truck house.

JOHN & CAMPBELL, Frankford, Pa., heating residence of Paul Albert.

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ZOLLER & CRAIGHEAD, Richmond, Ind., heating school house, Camden, Ohio; heating new Elks' building, at Greensburg, Ind.

DAVID CRAIG, Boston, Mass., installing heating system in Broomfield Inn., Broomfield street, Boston.

HOWARD L. BYRNES, 3047 Frankford avenue, Philadelphia, Pa., heating residence.

MAKIN HEATING CO., 18 S. Seventh street, Philadelphia, Pa., heating large residence at 1723 Spruce street. Heating country mansion of H. M. Kneedler, at Chestnut Hill.

MONITOR STEAM GENERATOR CO., 53 North Seventh street, Philadelphia, heating residence at 496 Penn street.

ALLEN BLACK & CO., St. Paul, Minn., heating and plumbing the Anoka and Hastings hospitals.

SPEAR & HANSON, Chicago, Ill., heating Majestic Hotel, Lake Charles, La.

H. DOERNING, Auglaize, Ohio, heating new opera house.

F. A. SUSTINS, Stevens' Point, Wis., heating Peters school.

R. N. DIXON, Albion, Ill., heating Schleuter building.

ANGELHART & HITCHCOCK, Atlanta, Ga., heating Home for Incurables.

WILLIAM O'BRIEN, Trenton, N. J., heating and plumbing St. Michael's Orphanage.

CHARLES SOAMES, Peru, Ind., heating county house.

M. C. HONEYWELL, Wabash, Ind., heating and plumbing residence at Winnemac.

T. K. JONES & BRO., Dover, Ill., heating Dover Opera House.

R. D. DIXON, Alton, Ill., heating Schleuter building, Second street.

CHURCHILL & WASHBURN, Brockton, Mass., heating new hospital.

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L. H. KURTZ & SON, Des Moines, Ia., heating and plumbing State College, at Ames, Ia.

W. F. SHALER, Grass Lake, Mich., heating residence on East Main street.

MAY BROS., Dyersville, Ia., heating Sisters' Home.

DREXEL PLUMBING & HEATING CO., West Point, Neb., heating court house.

VAN SICKLE & WARREN, Cleveland, Ohio, heating residence of Dr. Ingersoll.

R. E. HARRIS, Macomb, Ill., heating residence of East Calhoun street, and building on East Side Square.

H. McELWEE, 2029 E. Huntington street, Philadelphia, heating residence on Clearfield street.

SHEETS & HEBDEN, 37 N. Seventeenth street, Philadelphia, heating residence of Charles H. Bond, Norwood, Pa.

JOHN A. QUINN, 1613 Unity street, Philadelphia, heating and plumbing four new houses on Harrison street.

A. H. KIRBY, 3508 Kensington avenue, Philadelphia, heating building at 3527 Kensington avenue.

W. B. HOUGHTON, 2153 E. York street, Philadelphia, heating and plumbing building at 1430 North Second street.

NEWTON & GRAY, 1210 Samson street, Philadelphia, heating and plumbing fire house at Twenty-second street and Fairmount avenue.

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